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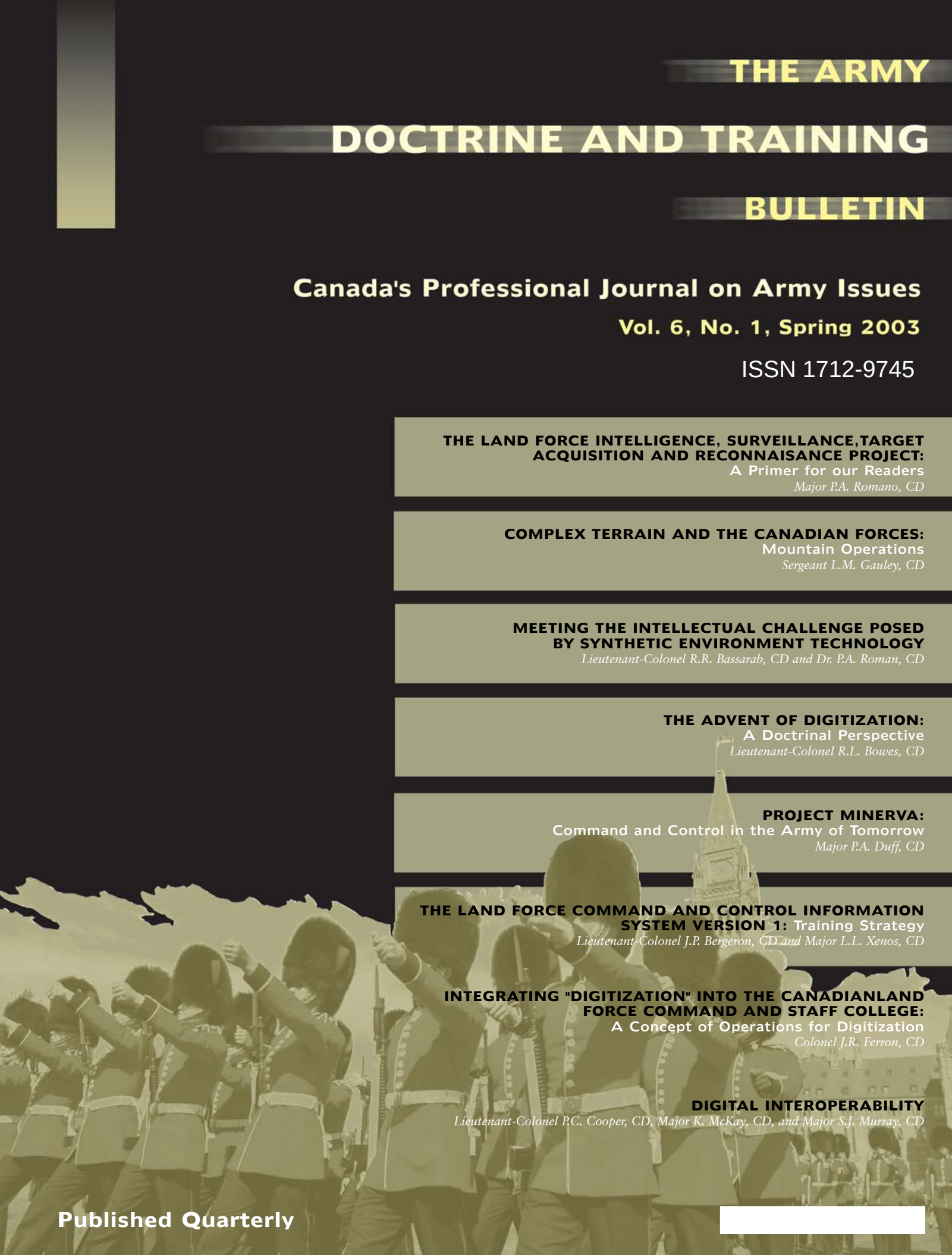

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This is an official publication of Land Force Command and is published quarterly. The Army Doctrine and Training Bulletin is dedicated to the dissemination and discussion of doctrinal and training concepts, ideas, and opinions by all army personnel and those civilians with an interest in doctrinal, training, and other military matters. Articles on related subjects such as leadership, ethics, technology, and military history are also invited. Considered, reasoned debate is central to the intellectual health of the Army and the production of valid doctrine and training policies. Articles promoting thought and discussion are therefore welcome. All ranks and personnel from other environments are encouraged to contribute. Opinions expressed in the articles remain those of the author and do not represent departmental or Canadian Forces policy. The doctrine, training, and other updates do not represent authority for action on that particular topic.

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Contributions to the Book Review section should be between 1,000 and 2,500 words. Guidelines for the preparation of book reviews can be obtained from the Managing Editor. Where possible, an electronic copy of the dust jacket of the book being reviewed should be provided.

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A Part of Our Heritage

Engineers: The fortifiers, builders and shapers of Canada

Whether it was fortifications, civil construction, canals or sieges, military engineers designed and led their construction or planned their investment. Always few in number, their legacy remains with us today.

A King's Engineer, New France, mid-eighteenth century. The era of Canadian military engineering commenced in the 1680s, with the appointment of the first permanent engineers. They were responsible for fortifications and building. (Courtesy Parks Canada)

A fanciful view of an officer of the Royal Engineers with a Sapper, early 1815. Composed exclusively of officers, a few members of the Royal Engineers served in Canada during the War of 1812. They developed land and water routes, designed and built fortifications. The labour came from the infantry, civilians, or the Royal Sappers and Miners. (Courtesy Greenhill Books)

Officers of the Royal Engineers, 1846. Considerable fortification and canal construction occurred during this period as another war with the United States appeared likely. (Courtesy Anne S.K. Brown Military Collection)

Canadian engineer companies grew out of the volunteer movement in the 1850s. An early unit was the Toronto Engineer Company, formed in January 1876 and disbanded in 1881. In 1884, an Engineer Branch was established in Ottawa and units for the Permanent Active Militia authorised in 1903. The image shows an officer in full-dress mounted order in 1876. (Courtesy Directorate of History and Heritage)

Guest Editorial

Command and Control Aspects of Digitization

by Brigadier-General G.W. Nordick, M.S.C., CD

Last year was a ground breaking year for army digitization, with the completion of Tactical Command and Control and Communications System (TCCCS) distribution, the start of the Land Force Command and Control Information System (LFC2IS) experimentation and fielding, and the continued development of command support doctrine. Canada was also responsible for hosting Communications Interoperability Demonstration (CID) Borealis, an America-Britain-Canada-Australia (ABCA) communications and interoperability exercise, in Kingston during June 2002. All these activities have provided us with a glimpse of the future and caused considerable debate about where we go from here.

I participated in most of these major events, as a brigade commander during TCCCS fielding, as a brigade mentor during Army Experiment 6B (LFC2IS experimentation), and as the Exercise Director for CID Borealis. In addition, the Canadian Land Force Command and Staff College (CLFCSC) has been working hard to imbed LFC2IS into the new Army Operations Course (AOC). Finally, I had the honour of both participating in and presenting at two Digitization and Interoperability symposiums held in London, England in December 2002. These activities served to solidify some thoughts, which I intend to use to lead off this special feature of *The Army Doctrine and Training Bulletin* focussed on digitization.

Last year was a ground breaking year for army digitization.

First, it is clear that effective, robust, and survivable command and control (C2) systems remain the key to both combat effectiveness and interoperability. As long as we can talk and pass data effectively within both national and coalition chains of command, we can accept significant variances in equipment, structure, and even tactics and doctrine among the component parts.

We must also acknowledge that within coalitions there are multiple levels of C2 required for effective operations. The first domain is political, requiring robust communications among the political leadership that govern the coalition, within national governments themselves, and between a variety of supranational agencies (UN, for example). Given the existence of secure fixed networks, this level of communication is generally easily established. Next, is the civil-military domain, requiring clear lines of C2 between the politicians and the military at both the coalition and national levels. Again, given that the civil and military authorities are most often co-located, this level of C2 is relatively easy to establish and maintain. Finally, within the military domain, there must be effective C2 on both the coalition and national levels, at all levels from tactical to strategic, and in all environments (land, sea, air, and space). This last domain is extremely complex and has always been the hard nut to crack.

For example, we already know that military C2 must operate over long distances. Even today, echelons of command from tactical to strategic are no longer lined up one behind the other in a defined battlespace. Instead, as the war in Afghanistan demonstrates, digital C2 must function in the non-contiguous battlespace with higher headquarters and component parts located sometimes continents apart. For C2 at a distance to be effective, it must be reliable and survivable. In the long distance, non-contiguous battlespace, the commander will not have the option of dispatching a dispatch rider, sending a liaison officer, or climbing into his jeep, armoured vehicle, or helicopter to go forward for a chat with his subordinates. Hence, distance makes C2 reliant on technology. We must not, however, let C2 become technology dependent. Over reliance on digitization and technology could easily make our C2 systems a critical weakness and an unacceptable point of vulnerability. Any future C2 system that depends on one of a kind equipment which is not reliable in both training and operations and, most importantly, cannot withstand direct attack, could put our forces at risk.

Already complicated, the C2 problem is further compounded by the fact that there is a duplicate system operating on the opposing side of any conflict, which shares the same electronic spectrum and, in fact, may be working hard to exploit or take down our network. There are also a host of other legitimate entities in the battlespace (non-government organizations, for example) and other nations in the region, whether involved in the conflict or not, with whom we may need to communicate and who have a right to communicate. That communication may well be problematic, for we are not all using the same equipment, procedures,

formats, protocols, and software. Finally, we are constantly torn between our desire to share information and our need to protect national interests.

I have outlined this problem to remind us that we too often take C2 for granted, forgetting that achieving effective and interoperable C2 is hard work, which requires constant effort. From the Canadian perspective, it may be tough to acknowledge, but LFC2IS is already a legacy system, despite the fact that we have not yet started operational fielding. Even as it enters service, we know that we will have interoperability problems not just with our allies but also with the other services in Canada.

This serves to highlight how we must change in the future. Essential interoperability goals must be built into the requirements documents of all future C2 systems and, perhaps, into a broad range of other digital systems. As TCCCS and LFC2IS have demonstrated, new systems are so expensive that we must accept we will not be able to afford frequent wholesale replacement of entire C2 fleets just to keep up with technology. Instead, new and legacy systems must be able to function together seamlessly even if certain features of the newer systems must be disabled in order to ensure that the essential elements—basic communication and data transfer between the new and legacy systems—will still be possible. Today we build new systems and then work on ways of making them function with legacy systems. For tomorrow we must insert innovative solutions at the front end that will make interoperability patches unnecessary. Digital hardware must be built to be adaptable and flexible, so that it can easily incorporate new software. Impossible you say–I think not. The US, with a far larger problem than ours, is in the process of fielding the Joint Tactical Radio System (JTARs). This radio is essentially a generic hardware tray, into which one puts cards filled with the waveforms of various radios. These waveforms are captured digitally and thus can be downloaded when required to communicate with a particular radio system. The concept has incredible potential for national and international interoperability across the entire electronic spectrum.

The Army Strategy also makes our interoperability priorities clear. First, we need to be interoperable within the CF. Our next priority is interoperability with the Americans, followed by ABCA nations, and then NATO. This interoperability prioritization gives us clear goals. It does not, however, absolve us from the need to be able to operate in ad hoc coalitions such as those formed by the UN. Therefore, the C2 work we are undertaking within forums such as the ABCA, NATO, the Multinational Interoperability Council (MIC), and the Multinational Interoperability Programme (MIP) remains critical to future success. That C2 work notwithstanding, digital interoperability is not just about building ways to work with other digitally equipped nations but must also address how to function effectively with nations, formations or units who do not have this capability.

Information technology (IT), information management (IM), digital technologies, and the growing web of ISTAR (Information, Surveillance, Target Acquisition, and Reconnaissance) systems are enablers, critical enablers, to achieving C2, but they are not a panacea and cannot be permitted to drive the system. To defeat both conventional and asymmetric enemies, we need to achieve information dominance. IT/IM, ISTAR, and digitization give us the tools to create knowledge and augment our abilities to act decisively and with precision, to protect ourselves (both in the homeland and in the theatre of operations), and to improve human decision-making both political and military. These tools also permit us to operate effectively over vast distances, in the non-contiguous battlespace. Moreover, they offer excellent methods of handling information, which should significantly speed up our ability to conduct after action reviews, thereby allowing us to learn and adjust our tactics and doctrine while still engaged in high tempo operations.

In order to achieve information dominance, a common operating picture that is based on accurate and shared situational awareness must be compiled. That situational awareness, in turn, is based on three requirements. The first requirement is for near perfect Blue situational awareness. Knowing accurately where one's own forces are and their current state of readiness is critical to force protection, prevention of fratricide, rapid action or counter-action, and logistics. The second requirement is for interactive Brown situational awareness. A full understanding of the battlespace environment and an ability to manipulate brown data to assist in planning, war gaming, etc, offers significant advantages (terrain fly through, movement planning, barrier planning, positioning of ISTAR and C2 assets, etc). The third requirement is for the most accurate possible Red (OPFOR) situational awareness, including physical locations, intentions, and the psychological situation.

Given the increasing number of sensors that can provide information in all three of these areas, there is a growing need for

Digital hardware must be built to be adaptable and flexible, so that it can easily incorporate new software.

Brigadier-General G.W. Nordick, M.S.C., CD

information fusion to reduce duplication, to prioritize information, and to provide analysis wherever possible. Effective fusion requires close human and machine interface and is a critical element of digitization.

In this regard we are still trapped by the past. Our focus on open terrain has driven sensor development for the past twenty years. An opposing force that operates in the open is constantly at risk, as this is where the full spectrum of existing sensors and weapons can be brought to bear. However, with the growing realization that the battleground is moving into the urban areas and other complex environments, we need to dramatically shift our focus. Can we find scattered belligerents in a sea of thousands or even millions? Can we control and conduct effective surveillance of hostile non-combatant populations that may be assisting or hiding those that oppose us? Can we protect our soldiers, C2 assets, and combat service support in a complicated urban environment and still fight effectively?

We need to continually remind ourselves that, at the core, C2 is still a human activity and that we should be fortifying this aspect of C2. Humans are still the best sensor platforms, and our digitization efforts should seek to enhance their capabilities and not focus on replacing them. Technology can be fooled, and we must not underestimate the value of the "human in the loop" when it comes to verifying and validating information. For too many years we have also ignored cheap and effective options already at hand (the employment of dogs, for example) for a broad range of sensor requirements such as detection duties (mines, drugs, explosives, firearms, people), early warning, and force protection (sentry, crowd control, non-lethal force, etc). Our search for the best solutions must be broad based and not focussed only on technology.

To this end, I think we all accept that technology is not a guarantee of success. Even perfect situational awareness (Blue, Red, and Brown) will not guarantee success because humans, not technology, are the essential element of military operations. Digitization has the potential to enhance our abilities, but we will not win wars unless there is national and coalition will to both engage and to stay the course, we have excellent leadership and human decision making, we have superb tactical skills, and we have the ability to effectively and skilfully employ all resources at our disposal. Digitization by itself will not guarantee any of these capabilities and is just one more club in the golf bag.

A fundamental understanding of C2 and the human dimension of operations is critical as we continue to refine our command support capability. Today, the physical and human costs of digitization should be sending up warning flags. If we in fact reach the stage where we can only afford one centralized command support organisation, built on stressed trades and irreplaceable equipments, will we meet the requirement for a survivable and redundant C2 system that will stand the stress of combat? What is our backup plan when the digital brigade headquarters is struck, whether by rockets or a cyber attack that destroys the Fusion Cell? We can afford specialization in a wide variety of capabilities, but can we really afford to take this risk with our C2 system?

To be truly successful, digitization must also exist across the battlespace. For too many years we have ignored the requirement for tight and robust control of the rear area. As a result, in the non-contiguous battlespace, our essential logistics tail is often a critical weakness. We do not know accurately where our troops are in the rear area, we have not provided proper situational awareness tools to those responsible for coordinating rear area security, and troops in the rear are not equipped to react to enemy action and do not have the ISTAR resources to protect themselves on a continuous basis. Our CSS forces are structured for a traditional battlespace, where a relatively secure rear area is assured. As well, structuring is based on fighting in the open, using the premise that we would avoid fighting and operating in built up areas. This will have to change. Command support must develop a single, consolidated approach to C2 that will exist across the entire battlespace.

Command and control is still a human activity.

Finally, we need to acknowledge a growing reality as we march down the digital road. There is no slow approach. You are either digital in focus or you are not. And once committed, the technical, doctrinal, and structural changes required to keep up can be breathtaking. The Army is well and truly started down the digital road, and warp speed is almost upon us. So hang on because the ride is already exciting.

From the Directorate of Army Training

Tactics School and the Army Tactical Operations Course

by Major R.T. Cotton, CD, Chief Instructor Tactics School

For the past two decades, the Tactics School has been training lieutenants, captains and majors belonging to the Regular and Reserve Force in all aspects of military tactics. As part of the Combat Training Centre (CTC) in Gagetown, the school has been responsible for conducting the Intermediate Tactics Course (ITC), Advanced Classification Training Infantry and Armour (ACT [Inf] and ACT [Armd]) and the Combat Team Commander's Course (CTCC).

The Tactics School is currently re-designing and updating its courses as part of the Army's Officer Professional Development Review. The most recent creation of the school, and successor to the ITC, is the Army Tactical Operations Course (ATOC). Throughout the development of the course, efforts were made to improve course content by tailoring the curriculum to meet the needs of the candidate more precisely and to take full advantage of technology and modern teaching methods, specifically distance learning (DL) to improve the quality of life for students and staff.

ATOC is composed of the seven modules shown in table 1. During the process of developing the training plan (TP), it became clear that, in order to practice what we preach, it would be necessary to create two separate versions of the course. The end-state of many months of planning and development saw the creation of two courses. The first version, ATOC—Combat Arms (CA), consists of modules one to six and is aimed at training combat arms lieutenants and junior captains in the tactics of fighting a combat team or in supporting combat team operations. The second version, the ATOC—Combat Service Support (CSS), is made up of the first six modules plus module seven and will train CSS lieutenants and junior captains in key appointments in CA administrative companies, squadrons or batteries and for work in the Close Support and General Support Service Battalion Log Ops and sub-unit command posts. This course emphasizes support to tactical operations, i.e., combat units within a brigade context.

In March 2003, a pilot course for the CA was conducted to evaluate the first six modules of the ATOC. A similar evaluation is planned for the ATOC—CSS with the additional seventh module in April 2003.

The School Standards Section, charged with creating both programs, followed the principle of placing theoretical work into the DL portion of the course while focusing the Residency portion on the practical application of knowledge and skills in syndicate discussions, tactical exercises without troops

Module 1—Command Theory and the Operational Environment
Module 2—Battle Procedure Focusing on Recce Plans and the Combat Estimate
Modules 3 to 5—Offensive, Defensive and Delay Operations Respectively
Module 6—Transitional Phases of War
Module 7—Sustainment Operations in Support of Combat Units with a Brigade.

Table 1: The seven modules of ATOC.

The Tactics School is currently re-designing and updating its courses.

Syndicate work is critical to developing an understanding of concepts and ideas presented on the ATOC. (Courtesy CTC)

The Directing Staff ensure all material is covered, largely through the active participation of students—from a mix of corps and branches—within the syndicate. (Courtesy CTC)

(TEWTs) and Janus computer assisted exercises (CAXs). The school has long been at the forefront of the development of DL and electronic learning (E-Learning) with such products as the DL packages associated with both ITC and the Primary Leadership Qualification (PLQ-L). Distance learning consists of both unassisted and assisted training using the software program WebCT and teleconference technologies. The use of DL is becoming common throughout the CF, and the benefits, challenges and potential of DL are being explored across the spectrum of individual training. While Tactics School personnel gained experience in the field of DL production during the production of the ITC 1 and the PLQ courses, the ATOC development team took advantage of advances in the development of DL throughout the academic world, the Army and the Canadian Forces in general.

The school, along with following organizations, has put a good deal of effort into the creation of the DL portions of each course to provide a quality product: Combat Training Aids Production Centre (CTAPC) provided the technical input, Canadian Forces Training Development Centre (CFTDC) Borden provided initial guidance and assisted with the production of DL modules, Canadian Land Force Command and Staff College (CLFCSC) provided the lessons learned during their development of the Army Operations Course (AOC), and the Canadian Defence Academy (CDA) and The Royal Military College of Canada (RMC) provided technical assistance getting the course on-line (intranet and eventually internet) through RMC's server learning management system (LMS).

The LMS allows students to log on and review the courseware from previous DL courses. It will be the electronic equivalent of that box full of old course notes in your basement that you refer to before attending a course to "refresh" yourself, although the LMS will also allow you to challenge test and review online discussions. The WebCT server at RMC is used to manage both ATOC course packages. WebCT is a commercial LMS that provides course management, a means of communicating both synchronously and asynchronously with students, the ability to administer and track tests and results and the ability to track student accessing time to various portions of the courseware.

ATOC-CA has a total of sevens days of DL, which is conducted in the candidates' home location and is followed up with a ten-day training portion in-residence at CTC Gagetown. Students on the ATOC-CSS have nine days of DL, followed by an eight-day in-residence portion also held at CTC Gagetown.

Once loaded on the course, each student will receive electronic joining instructions that will direct them to the Tactics School website and ultimately to WebCT. Once on WebCT, they will be presented with the ATOC courseware as well as information from DS, syndicate discussion groups, a white board and on-line tests.

This flexible method of delivery makes it easy for reservists to complete the same training as their Regular Force counterparts. A Primary Reserve (PRes) ATOC for the CA, for example, will have a five-day portion of unassisted DL at the home location, followed by 12 days of in-residence training at CTC Gagetown. The two extra days of in-residence training will address the difficulties of Reserve Force personnel completing synchronous discussion during DL. A PRes ATOC-CSS will be piloted in summer 2004.

As the complexity of the Army operations, equipment and tactics continues to grow, we must continue to remain at the forefront of evolving training strategies.

Anticipating future Army training requirements, CTC and LFDTS, at the CTC Professional Development Symposium in February 2003,

Problems are also discussed during TEWTs where considerations of ground (and weather) play a greater role than in a map study. (Courtesy CTC)

developed policies to ensure the full range of benefits are gained from the use of DL in Army training. Keeping in mind that DL is not a universal remedy for training, but it does offer new and exciting delivery strategies for individual training and will allow us to harness existing civilian training methods and technologies. As the complexity of the Army operations, equipment and tactics continues to grow, we must continue to remain at the forefront of evolving training strategies.

Based on observations from the ATOC-CA, ATOC-CSS and PRes ATOC-CA pilots being run from March and June 2003, Tactics School will make necessary improvements and will offer finalized versions of the courses in October 2003. The School will program five ATOC-CA serials, five ATOC-CSS serials and two PRES ATOC-CA serials annually.

For more information on the ATOC, please visit the Tactics School website (http://ctc.gagetown.mil.ca/tactics/index_e.cfm) or phone Tactics School Standards Section at CSN 432-2643.

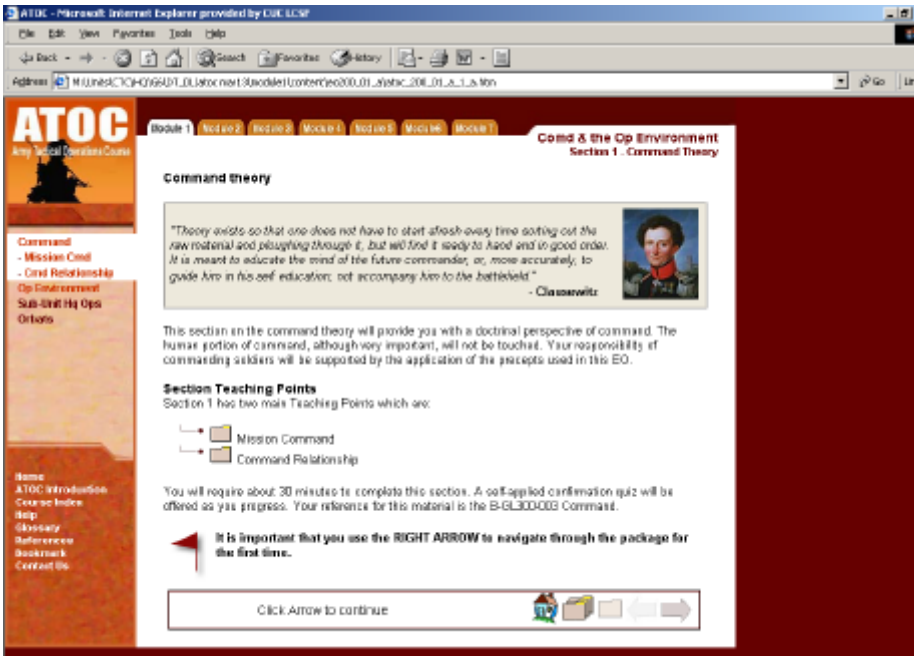


Figure 1: Shows the typical layout of a DL page.

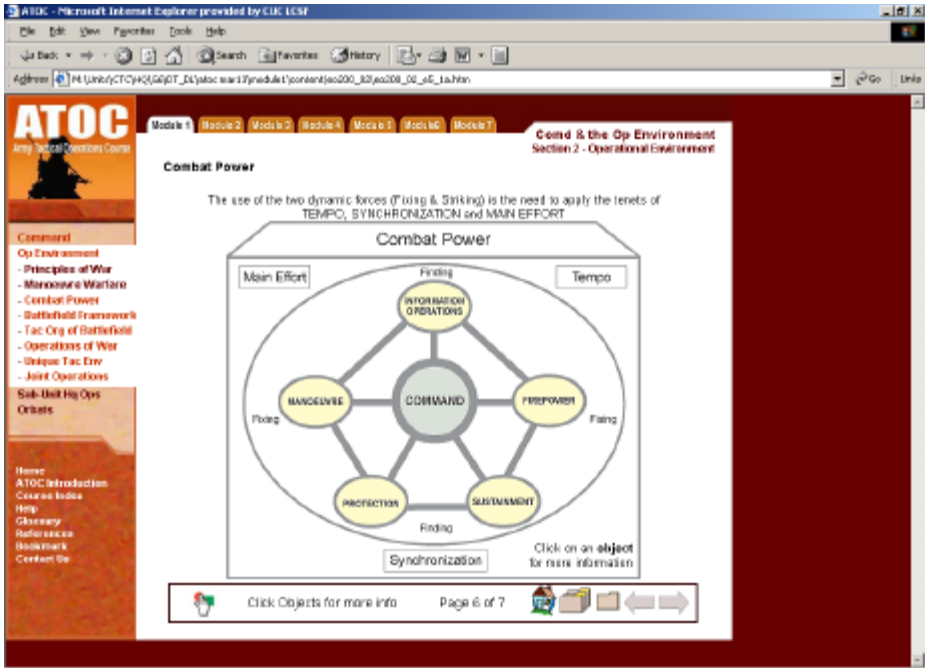


Figure 2: Depicts a typical page found in a DL module. Module pages are designed with "cursor over" capabilities, where pop-up windows provide additional detail on a specific topic, as well as photos, video, audio, flash graphics and other interactive elements.

The Land Force Intelligence, Surveillance, Target Acquisition and Reconnaissance Project

A Primer for Our Readers

by Major P.A. Romano, CD

Based on a Presentation
At the Army ISTAR Symposium,
10–11 February 2003,
Kingston, Ontario
Sponsored by the Directorate of Army Doctrine

The concept of intelligence, surveillance, target acquisition and reconnaissance (ISTAR) is not new to the Army. The various components of ISTAR and, to a certain degree, the linked process has been used on operations by the field force for many years. The Land Force Intelligence, Surveillance, Target Acquisition and Reconnaissance (LF ISTAR) Project is the means to conduct studies and procure equipment to realize the vision of an integrated ISTAR system. This article will provide a synopsis of the LF ISTAR Project in order to understand how the capability will be implemented within the Army equipment program.

The aim of the LF ISTAR Project is "to deliver an integrated, interoperable LF ISTAR capability that will improve the ability of decision makers to visualize the battle space, manage LF ISTAR resources, and plan and implement actions to achieve mission success." There are several parts of this statement that need to be emphasized.

The project has the mandate to provide a system that is integrated. This statement means that the intelligence automation tools will be integrated with the Land Force Command and Control Information System (LFC2IS). The communications components will be integrated into the Iris bearer system. Furthermore, both new and in-service sensors will be integrated into a coherent information collection system.

LF ISTAR will enhance the Army's ability to work with the other environments and with the joint staff. It will also enhance interoperability with our allies. The focus for ISTAR is on providing a capability. This implies that we will address all of the aspects of the PRICIE model. This will be accomplished in cooperation with the various directorates within the Land Staff and with agencies across the department.

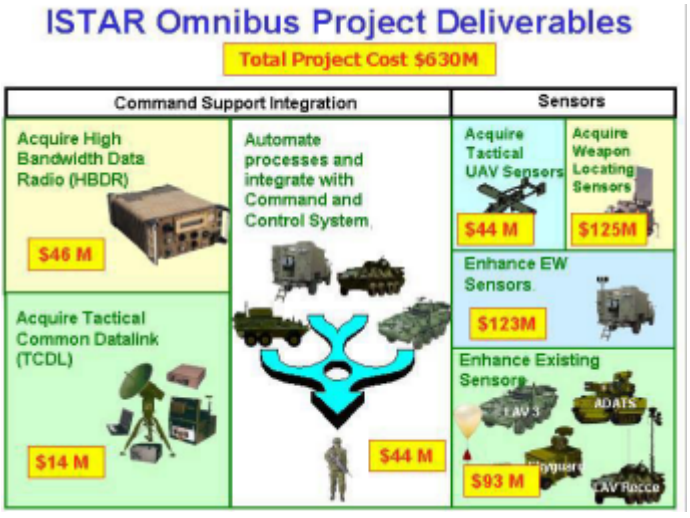
The project has been designed as an omnibus that will improve the Army's ISTAR capability one step at a time. Through this evolutionary development, we may achieve revolutionary change; however, the intention is to enhance the capability.

The designation of "decision maker" has been chosen to provide the sense of the universality of the system that is planned. While primary focus is at the brigade and battalion level, the project will consider any opportunities to provide relevant, accurate and timely information to all members of the field force.

The ISTAR project was introduced to address several capability deficiencies. Dividing the project into two components, command support integration and sensors, will cater to these deficiencies.

The focus for ISTAR is on providing a capability.

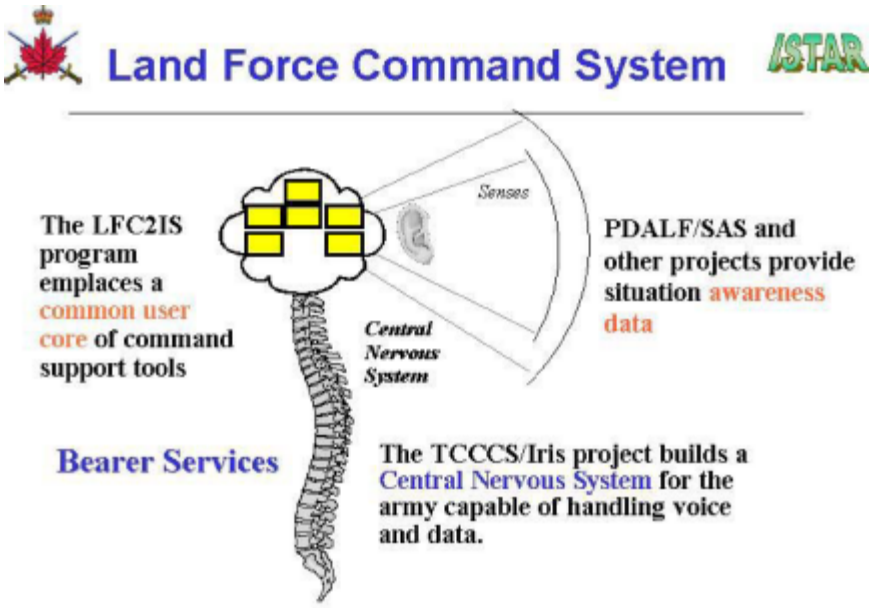
While the Tactical Command and Control Communications System (TCCCS) project provided the Army with a leading edge communications system, it lacks the throughput to



pass high volumes of data and images. To address this deficiency, new radios will be bought that will increase the capacity of the Iris bearer system for mobile sensors and command vehicles.

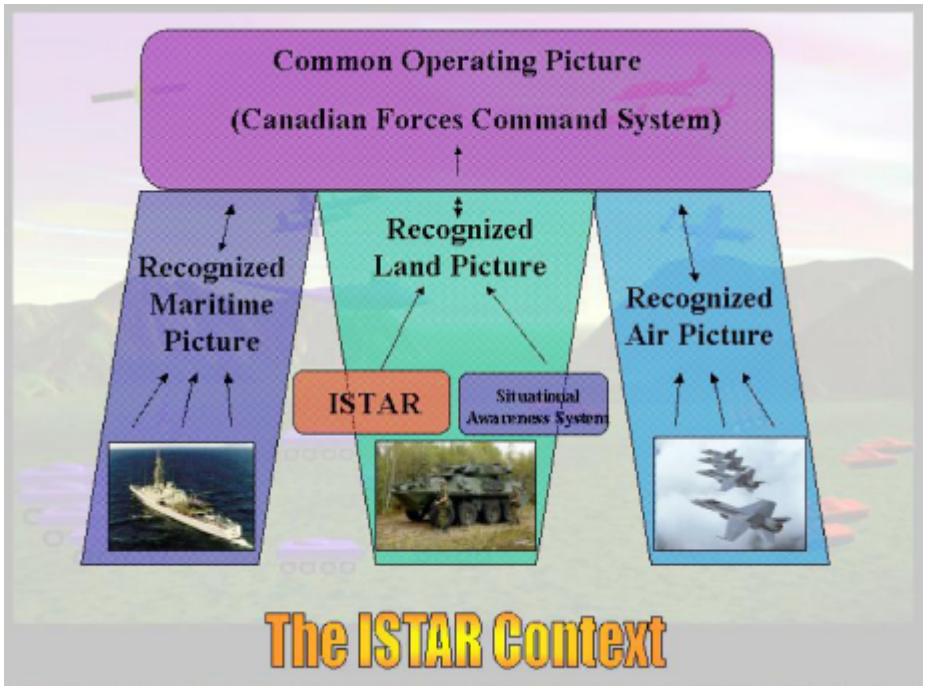
Next, the Army currently has no means of receiving data and images directly from aerial platforms like the Aurora and allied unmanned aerial vehicles (UAVs). Therefore, a common data link will be procured to provide a direct communications channel from airborne platforms to the ground.

Although, the Land Force Command System (LFCS) is providing new command and control tools, additional functionality is required. Intelligence tools are still needed to collect, analyse and disseminate intelligence electronically. A better link between our national assets and our deployed troops is also required. These requirements will be met by purchasing software components, command posts and computer hardware to enhance the LFCS. These tools will automate our intelligence process and enhance the link with the joint intelligence, surveillance and reconnaissance system.



Finally, the Army requires modern sensors. Soldiers need the capability to complete reconnaissance tasks and to identify and locate targets that are beyond direct line of sight. A family of UAVs will help provide this capability. The Land Force still does not have the ability to detect hostile indirect fire. To address this requirement, the project will acquire a weapon locating radar system to detect mortar, rocket and artillery fire. Current electronic warfare platforms cannot detect modern signals of interest. The plan is to enhance them, in a modular manner, providing the capability to detect, locate and intercept communications signals including frequency hoppers and unconventional communications technologies. Lastly, in-service sensors like Coyote cannot share information electronically. As part of the project, in-service sensors will be integrated and made network ready so that the data they collect may be clearly and rapidly shared.

The Army requires modern sensors.



Major P.A. Romano, CD

The LF ISTAR project will provide the Army with brown (geographical and meteorological data) and red (information on enemy or hostile forces) situational awareness. These components, fused with the blue or friendly situation provided by the situational awareness system, will form the recognized land picture to be used by commanders to make timely, accurate decisions. The information will be shared with the overall common operating picture to provide situational awareness across the CF.

Above is a graphical depiction of the LFCS. It consists of three components:

the TCCCS/Iris communications backbone, the Land Force Command and Control Program (also known as LFC2IS), depicted as the brain which automates the command and control functions, and the sensors portion, depicted as eyes and ears of the system, which provides detailed information on the operating environment. The LF ISTAR omnibus proposes to enhance this system. Additional bandwidth from new data radios and tactical data links will improve the backbone. The command support functions will be provided with additional tools to automate the intelligence process and information collection. Existing sensors will be improved and enhanced, and new sensors will be procured to provide a more balanced, multi-spectral view of the battle-space.

The brain of the LFCS consists of many applications that provide the necessary command and control tools for the commander and staff. These include:

Athene Tactical System (ATS). ATS is the principle C2 tool at formation and unit HQ levels. Users access operational information through a number of tactical overlays, which represent the unit and control features on the battlefield. In addition to organizing and displaying data in an easily understood form, ATS provides a number of analytic tools to manipulate the data to assist in the planning future activities.

The Operational Planning Environment and Reference Application (OPERA). The OPERA software module contains a suite of tools hosted on the user terminals within an HQ node. It is intended to be an electronic version of the traditional "Battle Box" carried into the field to provide planning guidelines and guidance. OPERA also provides the staff with a number of specific browser and tools in support of particular computation-intensive planning activities carried out at unit and formation level. These include ORBATs, equipment holdings, logistics planners and movement planners.

The Land Force Content Management System (LFCMS). The LFCMS provides the HQ node with common electronic document storage, retrieval and management capabilities.

Situational Awareness System (SAS). Situational awareness, the knowledge of where your forces are located, is a key component of LFC2IS. The Situational Awareness System (SAS) consists of two parts: a rugged GPS receiver that provides position and timing information and uses Iris radio nets to automatically transmit to all other SAS users, and the Situational Awareness Module (SAM), a software programme presenting C2 information graphically.

The Army Knowledge Management System (AKMS). AKMS provides the user search capability on training, doctrine and system information as well as a repository for operational and training lessons learned. This component amalgamates the existing doctrine, TTPs, and user and system documentation. It also provides the user with the ability to provide feedback on these information elements.

LF ISTAR will provide additional functionality to those currently provided by LFC2IS. For example, one major concern is collection management. The task manager of LF ISTAR assets needs automated tools to provide up-to-date status of LF ISTAR assets within the area of operation and to properly manage and coordinate the tasking of those collection assets. Another area of interest is to provide tools to improve the analysis and fusion of information. As more sensors are integrated into the command system, we risk overwhelming our intelligence staff with huge amounts of information. The all-source cell will require an increased capability to process and analyze more information, more quickly.

As discussed previously, the deployment of command support tools will be evolutionary. During the period from where we are today until the realization of the Army of Tomorrow in 2012, there are four or five major revisions planned with minor revisions in between. These incremental builds of the command system will govern the fielding of the LF ISTAR project. Our challenge will be to ensure that the project's development process matches that of the command and control system so that they are effectively fielded, together.

As the ISTAR project continues toward its goals, the ISTAR system will continue to evolve with and outside the project. Urgent operational requirements will not be neglected and should only help to facilitate the road to an integrated ISTAR system. ISTAR's ultimate goal is to provide better information for our commanders, resulting in smarter decisions for our soldiers.

Our challenge will be to ensure that the project's development process matches that of the command and control system...

Complex Terrain and the Canadian Forces

Mountain Operations

by Sergeant L.M. Gauley, CD

The aim of this article is to justify the requirement for and enhancement of a military mountaineering capability within the CF. It will suggest ways to enhance mountain training and the conduct of mountain operations, while detailing the relevance of military mountaineering to a wide range of CF operations. Moreover, it will suggest, as a starting point for scrutiny and debate, a path to improving our mountain operations capabilities in view of meeting demands across the spectrum of operations.

INTRODUCTION

On 13 March, 2002, the 3rd Battalion, Princess Patricia's Canadian Light Infantry air launched an assault onto the Tergul mountain range in the Shah-I-Kot valley in eastern Afghanistan. Within hours, the infantry battalion group was conducting offensive operations at an elevation of 3500 m above sea level. The necessity of knowing how to conduct mountain operations is a reality in the CF today.

The effective conduct of military operations in mountainous terrain requires specialty training. This is not a point of contention. However, the CF currently continues to conduct mountain operations courses in a fragmented and decentralized fashion, with the end result being a fragmented core of expertise. One might argue that the CF subject matter expertise in military mountaineering should reside with light land force units. In the wake of Operation APOLLO, the CF has reconsidered the fate of its light forces, thus providing the platform for future development.

Since the formation of the light battalions, each battalion has, of its own accord, chosen to continue mountain training.[1] In so doing, there is a degree of capability within the CF. But how extensive is our actual capability? Can the CF sustain itself in a mountain operation?

Mountainous terrain is defined as land forms higher than 600 m above the surrounding plain and characterized by steep slopes. However, the applications of military mountaineering are not strictly limited to the mountains. Virtually any terrain that comprises steep slopes, cliffs, deep valleys, or even plateaus or passes at altitudes over 2000 m above sea level presents unique complications to any unit.

Realizing the number of qualified advanced mountain operators in the CF and the infrequency of mountain courses and exercises, there is room for improvement in the CF's approach to mountain operations. Geographically, the Army has one brigade near the mountains. However, Canada has a diverse geography allowing for mountain training in other brigades since mountainous terrain exists in virtually every province. In order to expand or develop our capabilities in mountainous terrain, the functionality of such an idea must first be examined. The primary role of the CF is to defend Canada. As our mountains do not mark a border with a potentially hostile neighbor, it is hardly applicable to compare our mountain capability with that of some European armies. However, as long as wars are fought and futures are decided by wars fought in complex terrain, it is in our interest to maintain a certain level of capability in military mountaineering.

The effective conduct of military operations in mountainous terrain requires specialty training.

MILITARY MOUNTAINEERING

There are many misconceptions about what exactly military mountaineering is. The most common misconception is that military mountaineering is strictly limited to technical climbing requiring extreme abilities. Other false impressions range from the mistaken belief that military mountaineering is limited only to those in the special forces to the idea that any unit can function in mountainous terrain with very little or no preparation. The reality falls somewhere in between those two extremes. The ability of military units to conduct all phases of operations in mountainous terrain requires that soldiers receive instruction in a variety of technical and/or non-technical skills which may best be described as military mountaineering.

There is no question that there is a requirement for the CF to be able to operate in mountainous terrain. In 2002 the CF and, in particular, the Army successfully completed two critical missions-operations GRIZZLY and AOPOLLO-that projected our land forces onto the global stage. Both operations relied on our ability to operate in mountainous terrain and were dependant on

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existing CF mountain operations doctrine.[2] The CF has been committed to operations in the predominantly mountainous terrain of the former Yugoslavia for the past decade.[3] It is worthy of speculation to consider the fate of CF personnel, for example, had the UN mandate changed in Croatia 1994 requiring offensive operations in a mountainous environment. Had the situation changed in Bosnia during the latter 1990s, requiring SFOR to conduct offensive operations in order to bring the opposing factions back to the bargaining table, could the CF have fulfilled its mandate? In addition, the applications of military mountaineering in operations other than war are numerous and require consideration (see Appendix 1 for a list of relevant CF operations).

It is important to note that the situation in the former Yugoslavia involved uniformed and organized personnel who answered to a recognized chain of command. The threats today are different, and they are taking the CF to more remote places to conduct operations. Like the tragedies of September 11, 2001, the deployment of Canadian ground forces to Afghanistan to fight terrorists was unanticipated. The mission was successful for the Canadian battalion group, and minimal casualties were suffered on offensive operations. Future deployments in the war against terrorism may find Canadian soldiers encountering an enemy who wishes to hold ground or bring the fight to coalition bases. These missions could also involve Canadian troops pursuing an enemy who has fled into mountains or caves. Current CF doctrine embraces the tactical aspects of mountainous terrain by mentioning it in our operational manuals. For example, subjects like ambush, tank hunting, and search procedure for enemy aircraft refer to mountainous terrain.[4] These subjects, however, only address the application, not the specific tactics, techniques, and procedures (TTP), of military mountaineering.

Individuals in the CF learn military mountaineering skills through the attainment of two course qualifications: Basic Mountain Operations (BMO) and Advanced Mountain Operations (AMO). As its title implies, the BMO course is the first and most basic formal step in the military mountaineering journey. In and of itself, the course provides soldiers with a solid foundation upon which to pursue further training, but skill fade is a constant concern. It is a minimum of seven days long. It is conducted at the unit level, and there are a total of eight performance objectives that must be achieved for qualification. Topics covered in the course range from knot tying to evacuation of casualties. Also, in order to qualify, the candidate must take part in a tactical exercise. This stage of the course is particularly important as learned skills may be exercised at night during a tactical scenario. Virtually any CF member is eligible for this course provided he/she is TQ 3 or above, qualified Standard First Aid, in good physical condition, and medically fit.[5]

Units within the Army combat arms are the most likely to conduct the BMO course. Depending on the tactical situation, any soldier involved in joint or combined operations may employ military mountaineering skills. Primarily, combat service support (CSS) units are not likely to possess AMO qualified personnel required to conduct this training. Also, CSS unit commanders may not recognize the requirement to have a capacity to operate in such terrain nor the flexibility to incorporate such training. Medical, transport, supply, electrical and mechanical engineers, signalers, clerks, chaplains, and Air Force or Navy liaison personnel may all find themselves involved in mountain operations. For example, 3 PPCLI mechanics and clerks were employed as integral parts of the battle group reserve with LZ and rear area security tasks during operations HARPOON and TORI, and battalion level combat air assaults into mountainous terrain occurred during Op APOLLO. Clearly, a lack of basic military mountaineering skills will impact operational effectiveness.

The Advanced Mountain Operations (AMO) course is a minimum of 42 days duration and conducted centrally by the Canadian Parachute Centre (CPC). The centralized conduct of the course ensures that standards remain consistent and that candidates are not subject to impartiality due to regimental affiliation. There are a total of seven main performance objectives that must be achieved for qualification. This course covers a myriad of subjects, ranging from basic skills such as techniques of manoeuvre to more complicated subjects such as mountain rescue and the tactical application of military mountaineering. Training in tactical applications serves as the knowledge base that allows AMO graduates to advise commanders during operations in mountainous terrain. During the AMO course, candidates generally take part in a tactical exercise with the assistance of a platoon of soldiers to which mobility is provided in various capacities. Successful nominees to the course will be BMO qualified, hold the rank of corporal or higher, be qualified Land Force Junior Non-Commissioned Officer (second lieutenant or higher for officers), be current in Emergency First Aid, be medically fit and meet specific medical category requirements, and finally be a volunteer.[6] Once qualified, the advanced mountain operator is able to instruct on the BMO course and, relying on principal procedures taught on the AMO course and experience, develop solutions for non-standard problems.

Other CF training courses are also applicable to the attainment and enhancement of military mountaineering skills. Given that at any time of year, snow can be found in most mountain ranges-particularly in the remote regions of Canada, Alaska, Asia (including China), Central and Eastern Europe, South America, the Middle East, and even Africa-operational ski training (a component of basic cold weather training) is very relevant to mountain operations. Another unique consideration is mobility in the mountains during the winter. The Nordic Ski Instructor course, though

targeting primarily sport and recreational activities, also touches upon the development of alpine ski touring skills.[7]

Other training sought out to enhance skills is conducted either at the unit level or at CPC. Such courses commonly taken are High Angle Rescue, which is a civilian course that can take the form of rope rigging and casualty evacuation in a structural environment such as bridges and buildings. This course can also be similar in nature to the AMO course, where like skills are taught entirely in mountainous terrain. Avalanche training is also common. This subject is covered briefly on the AMO course. However, the study of avalanches is an ongoing process since the science of snow is not, at present, thoroughly understood.[8]

Environmental training and awareness is of critical importance, and AMO training must be conducted at times and places designed to maximize limited resources. The AMO course, for example, is usually conducted in the May to August period in the Rocky Mountains of Alberta. Within this timeframe a large amount of detailed technical information covering, amongst other subjects, avalanche awareness must be passed to the candidates. It is unrealistic to only train in this terrain during the summer seson, as conditions can become severe in mountainous terrain during the winter months. Qualifying personnel as "experts" in mountain operations without addressing the dangerous subject of avalanches or specific techniques of ski movement in mountainous terrain presents a wide gap in our abilities. Avalanches kill many people every year in the Canadian Rockies. Guides, park wardens, backcountry skiers, snowboarders, climbers, and snow-shoers of all experience levels fall victim to this sometimes unpredictable killer. The summer period, however, does not provide the appropriate snow conditions or amount of snow at lower elevations where logical or safe instruction can be dispensed. Proper avalanche training, as for the AMO course, cannot be done on rotten and sun-baked snow found on summer glaciers.[9] In addition, the time allotted for avalanche training on the AMO course is only one 60 minute period. Those in civilian trades, by comparison, require considerably more training before they are considered for employment in avalanche terrain.[10]

At the advanced level, the issue of skill fade and technical currency is the greatest concern. In relative perspective, an advanced mountain operator (unlike a CF parachute instructor or jumpmaster) can instruct mountaineering techniques, be the authority to make safety decisions, and advise a unit commander on potential courses of action in mountainous terrain without touching a rope or practicing the mandatory skills required to operate at a competent level for an indefinite period. It is not realistic to assign the advance mountain operator difficult mountaineering tasks if the individual is not properly refreshed with the most recent applicable skill. Mountaineering techniques, equipment, and environmental knowledge are constantly evolving. Some techniques and procedures recognized as appropriate a few short years ago would be considered dangerous today.[11]

Additional relevant training is mostly individual, random, and suited to a variety of applications. Furthermore, this training is at the discretion of unit commanding officers, who may be restrained by budget, unit tasks, and, especially within the context of the current CF operational tempo, pre-deployment training.

In order to address all the gaps and shortfalls of in present military mountaineering skills, steps should be taken to expand, rationalize, centralize, and update mountain operations training. It is common to strive for order and simplicity in military training. Military mountain operations, by their very nature, are complex and intricate, thus difficult to train for. Some will argue that the requirement of mountain skills beyond those that are presently taught in the CF training system can be dealt with as the requirement for additional skills arises. However, it should be recognized that the requirement may be time sensitive and the skills we do possess may be obsolete and not sufficiently safe to conduct military mountaineering techniques not covered in CF courses.

The civilian mountaineering community, by contrast, is at the forefront of mountaineering development. Breakthroughs in equipment, techniques, ability, and exploration have attracted more public adventure-seeking attention, created a very competitive market, pushed safety standards higher, and brought access to areas previously believed impossible to attain. Development in mountaineering technology is ongoing and constant. Avoiding obsolescence in military mountaineering demands that the CF remain current with new trends and methods through routine trials and evaluation of equipment and techniques—something that doesn't happen today.

In order to stay abreast of the latest developments in civilian mountaineering, caving, and rescue techniques as well as equipment innovations, the military must pay attention to the civilian mountaineering community. Although the relationship between the civilian and military mountaineering communities has traditionally been mutually antagonistic, closer and formalized ties at the cadre level with recognized national and international centres of excellence would greatly enhance military mountaineering in the CF. The Association of Canadian

It is unrealistic to only train in this terrain during the summer season...

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Mountain Guides (ACMG), for example, provides many certifications in the civilian mountaineering field, culminating with guide-level qualifications. ACMG-certified personnel guide clients as a livelihood and thus possess what may be considered the wealth of mountaineering experience to be found in Canada. Therefore, a good relationship between the ACMG and CF would be of mutual benefit. In areas where the CF may need to develop training, the ACMG may have already gone. Sharing of information could save the CF time, money, and induce positive media-related exposure for the CF.

Ideally, and with a view to keeping abreast of mountaineering developments worldwide, information sharing should be considered beyond Canadian borders. Development of contacts with the Europe-based International Union of Alpinist Associations (UIAA) is a project worthy of future study. Moreover, in depth studies of foreign military mountaineering TTP would obviously affect our interoperability with close allies and perhaps enable the CF to fulfill future coalition requirements. Information sharing in the form of unit and personnel exchanges, attendance on mountain warfare-style courses, individual and unit participation in mountain training exercises, or joint expeditions to challenging mountains and extreme environments would conceivably be of great benefit. Advantages gained could be expected in the areas of inter-army cooperation, establishment of unit relationships, and a positive learning and working environment between allied and CF soldiers. Above all, the result could transform and improve CF war fighting doctrine and development.

CONCLUSION

In summary, the current CF military mountaineering capability is limited. The Cold War and its focus on developing the required philosophy to fight a large mechanized enemy in Western Europe channeled CF efforts away from specialized light forces for nearly half a century. Existing CF mountain training is an antiquated product of the Cold War that should be re-evaluated in light of the new threats on the horizon.

It does take specialty training to function in this type of complex terrain. Here a member of 8 Field Engineer Regiment takes part in an adventure training exercise in the Kananskis Mountains. (CourtesyCpl Mathew Martin, 8 Field Engineer Regiment)

In order to do so, the CF training deficit in mountain operations techniques must be addressed. Recognizing that a comprehensive revamping of training in all aspects pertaining to mountain operations is unrealistic and unnecessary, a creative approach designed to enhance military mountaineering within the context of existing organizational structures would seem to be most appropriate and attainable. Given that a review of the current courses and subsequent upgrade of them would be easier than the creation of new courses, the existing format of a basic and advanced course is a suitable foundation upon which to build improvements. However, other courses specific to identified areas of skill fade should be introduced. These could be hybrid courses that combine civilian and military methods and skills taught at appropriate venues during appropriate periods of the year.

Avalanche Training. Avalanches are obviously a concern. Apart from the inherent threat posed to any CF personnel likely to operate in avalanche terrain, avalanches can be used as a weapon if set off deliberately in ambush. Avalanches can also be manipulated to destroy enemy equipment and personnel or to deny routes or key ground. Snow, ice, rock, or earth avalanches may be used to achieve tactical or operational aims by precise placement of explosive charges or via direct or indirect fire resources. Such use would require in-depth understanding and knowledge of avalanches. Adequate training can only be conducted in the winter, thus requiring a winter supplement to mountain operations training.

The CF maintains a certain level of indirect fire expertise pertaining specifically to mountainous terrain and avalanche operations. In support of the Department of Environment and Parks Canada (DOEPC) and the Department of Transport (DOT), 1 RCHA conducts annual avalanche control in the Canadian Rockies. Areas of operations include Mt. Revelstoke, Roger's Pass, and Glacier National Park. The period of

deployment is 15 November through 15 April. The artillery detachments conduct observed day and night shoots with 105mm C-1 howitzers in order to trigger avalanches in remote areas, thus safeguarding the public from hazards and ensuring the Trans-Canada Highway remains open. The application of this domestic operation to CF operational capability is in the ability to conduct, and remain versed in, live artillery shoots in mountainous terrain. This is particularly important when considering the unique skills required to adjust fire in mountainous terrain, the ballistic effect of the thin air at elevations above 2400 m, and effectiveness of ammunition in varying terrain and conditions.[12]

Ski Training. Ski training should be a fundamental part of mountain training. Cross-country skiing is a key method of travel in snow covered mountainous terrain. As mentioned earlier, some of the world's mountains remain snow covered throughout the year. The ability to move large numbers of personnel over rough terrain via ski would, conceivably, be a considerable force multiplier during mountain operations. reakthroughs of technology in the civilian sport of Alpine Ski Touring could greatly influence military mobility. Obviously, such training can only be conducted in the winter.

Ice Climbing. At times, the only way to ascend a feature is by climbing ice. Ice, like snow, is a constantly changing element. In mountainous terrain ice can be part of a permanent glacier, never totally melting throughout the year, or a frozen waterfall. Frozen waterfalls can be found at low elevations in the mountains during cold weather. Training is required to determine the suitability and safeness of the ice and to safely ascend and protect against falls on steep ice. This training has been conducted in the summer months on glacial ice. However, in order to fully appreciate the differences between good and rotten glacial ice and safe and unsafe waterfall ice, this training should only be conducted in the winter months.

Confined Space Rescue. There is also room for improvement in the area of confined space operations. A confined space is defined as an enclosed area with limited access. During Operation CHEROKEE SKY, which took place during Operation APOLLO in Afghanistan, tasks were assigned directly to platoons involved in confined space operations. Termed sensitive site exploitations (SSE), these tasks had been previously assigned only to special operations forces (SOF) personnel.[13] Given that these operations were within the ability of conventional light infantry units, SOF personnel were spared for other tasks. SSE tasks involved dispatching CF members into suspected enemy cave complexes, some of which required technical applications of mountaineering and caving.[14] One passage, in particular, required lowering a combat engineer down a small shaft not much larger than his own body. The total distance lowered was nearly the full length of a 60 m rope. Training in the raising of a casualty is covered on the AMO course. However, there are very different factors to consider when dealing with a casualty in a confined space. This environment features unique objective hazards including darkness, extreme temperature change, flooded chambers, a limited supply of oxygen, and/or the presence of poisonous gasses.

Tactical challenges, too, require special attention in confined spaces. The specific demands of dependence on specialized equipment such as night vision goggles (NVG) and thermal detection devices, reaction to enemy contact, action upon detection or detonation of improvised explosive devices (IED) placed as booby-traps, action on incurring casualties, prisoners, or detainees, and virtually any other possible situation must be anticipated and prepared for. Operating in this extreme environment is not currently addressed in CF courses and has been proven to be a possible task to which CF personnel could be committed. This training applies to both mountain operations and urban operations.

Aid Climbing. Aid climbing is a technique that allows trained personnel to ascend what would otherwise seem impossible terrain. Aid climbing involves the direct use of equipment to climb instead of having to rely on solid hand and foot holds. Aid climbing can be applied to rock, ice, and man-made structures in an urban environment. The techniques required to aid climb are an extension of the techniques involved in lead climbing. Existing technology enables multi-day expeditions to climb enormous vertical terrain previously thought impossible. The ability to aid climb could serve the same purpose for the CF in that terrain previously believed to be impassible could be negotiated. With the obstacle having been overcome by AMO personnel, lines (ropes) could be fixed for basic mountain trained personnel to ascend. This subject has been of interest to CPC in the past but is not part of the AMO course training plan.

Bolting. Bolts are a type of anchor developed for use in the industrial world as an anchor to be set into concrete. Mountaineers use bolts in rock for anchors to safeguard against falls and for rappelling. In order to set bolts properly, training in rock and concrete suitability, drilling, proper torque, and technique is vital. Military applications are worth

Current CF doctrine recognizes the potential importance of livestock in view of enhancing mobility in mountainous terrain.

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consideration and apply to mountainous terrain and urban operations. This subject is not covered in the AMO course.

Mobility Training. The CF has expressed an interest in utilizing quad-type all terrain vehicles to enhance tactical mobility. This subject may be put into perspective by looking at the applications of the light over-snow vehicle (LOSV) and its success as a mobility provider during winter operations. The same benefits could easily be gained with the use of quads in more moderate weather and climates. Trials conducted by mechanized recce sections found that quads were a suitable for recce personnel to conduct a wide variety of missions. The use of such a vehicle in mountainous terrain would prove invaluable while like-equipped CSS units would have the ability to keep up with the demands of supported units. Similar vehicles were used during offensive operations by the CF in Afghanistan and were found to be a force multiplier and especially effective in supporting administration of sub-units. These small vehicles require personnel to be qualified in their operation, airmobile rigging, and their tactical use in mountainous terrain.

Current CF doctrine recognizes the potential importance of livestock in view of enhancing mobility in mountainous terrain. Within the last decade, the CF has used light artillery designed for use in mountainous terrain and transportable by pack animal.[15] Training with livestock, by and large, has degraded to the point of being virtually nonexistent. Being care intensive, livestock handling requires special attention and training. Food, proper load rigging, and, in some cases, farrier skills (e.g., shoeing) could be vital to mission success in mountainous terrain. During one incident on Operation HARPOON in Afghanistan, enemy personnel were encountered and ubsequently destroyed. Among them was a mule used to bear loads. Unfortunately, the mule's fate was that of collateral damage.[16] Had this not happened, the mule could have been turned over to the battalion transport officer for future use in re-supply, casualty evacuation, or as a heavy weapons transport.

High Altitude Training. Training for high altitude operations is very important since altitude can begin to affect soldiers at 2000 m. During operations conducted at high elevations in Afghanistan, the 10 Mountain Division observed that "almost everyone had some problems with the altitude at first." The most common affliction in this instance was acute mountain sickness, a condition which, if left untreated, can develop into a life-threatening condition. Without prior climatic conditioning, these soldiers initially deployed to elevations ranging between 2000 m and 2800 m. They subsequently climbed to over 3500 m in the space of 36 hours. It is recommended that ascents should not exceed 333 m per day. The worst cases had to be evacuated to lower elevations.[17]

Tests have been conducted where soldiers were air-lifted to altitudes of 3300 m to 5500 m resulting in an incapacity illness lasting two to five days. Nearly 40% of those afflicted still had symptoms after one week, and 13% remained afflicted after one month. Nine soldiers didn't acclimatize in six months and were unfit for duty at high altitudes. Some Chinese soldiers stationed at the Tibet Plateau cannot tolerate the altitude and are unfit for duty at altitude.[18]

Moreover, altitude affects the accuracy of weapons, including small arms. In combat, altitude changes the environmental demands on soldiers' bodies, adding to the extreme bodily stress. Near the poles, altitude entails greater complications than near the equator. That is to say, if Mount Everest were located where Mount McKinley (also known as Denali) is (in Alaska), it would be impossible for a human to climb it without oxygen. This is an extreme example, but it shows the relevance to how altitude could affect CF personnel operating in the Canadian north in mountainous terrain.

RECOMMENDATIONS

In order to ensure that the CF acquires the ability to effectively conduct mountain operations, Canadian Military Mountaineering conduct and training requires critical evaluation in view of determining the way ahead. Essentially, three options might be relevant within the context of the Army of Tomorrow. The first option would be to not change the system we have in place today in the hope that potential future requirements will diminish or disappear. As a second option, one might suggest that training to concretely identified needs through the co-option of civilian agency resources would be the most viable option. A third option would see the creation of a dedicated mountaineering cadre and school with a view to centralizing knowledge, expertise, and resources. Each option has its inherent advantages and disadvantages.

No Change. Certainly, some will argue that this is the most viable option. However, certain risk would be assumed by the CF were it to select this option. Although not changing the system would most likely be the most economical course of action, the shortfalls and gaps being realized on recent operations could very well be the trend of future CF operations. Numerous deficiencies can be expected:

- These operations could involve the contact of enemy personnel in mountainous terrain where the terrain can influence the outcome. If that is to be the case, the present capability in this terrain is not adequate.
- The commitment of CF personnel to conduct extended operations in mountainous terrain would require depth of knowledge in all elements involved, including CSS. Currently, CSS units lack mountain capability, and CSS set the conditions for the success of any operation.
- "The rugged terrain with its variable weather, snow, ice, and thin atmosphere may be as big a

problem as the enemy. Experience shows that to counter these elements, mountain troops require special training and equipment, a period of acclimatization to high altitude, and a clear understanding of this challenging terrain."[19]

- Domestic operations applications of current CF mountain skill and capacity such as a major air disaster (MAJAID) or large avalanche would, arguably, lead to embarrassment and damage the public faith in the CF and the federal government.
- Existing training does not define the applications of taught skills to urban operations.

Train to Need. A train-to-need approach would be more suitable than no change at all. However, the terms of train to need and how such a method would be achieved is open to interpretation. The cheapest solution would probably be the application of the most relevant civilian recreational skill to suit the CF requirement, like the sport of caving applied to SSE in cave complexes, alpine ski touring for a ski mounted operation in mountainous terrain, or high angle rescue for the occupation of observation posts in extreme terrain.

This course of action would provide a working knowledge of the skills required for negotiation of the terrain but not as applied to the CF. The sport of caving, for example, will not touch upon important subjects like weapons, night vision devices, mutual support methods, or booby-trap methods. Alpine touring will not cover how to react to effective enemy fire, proper fire positions, crawling techniques, or tracking. In addition, high angle rescue will not address the requirement for stealth, covered approaches, and the sustainability plan required for a covert operation. There are many skills that are vital to what we do in the CF that may seem too radical to civilian instructors. There is also the issue of the security of our exact capabilities and operational procedures.

The other method of training to need would involve the use of a mountain warfare cadre to conduct the training. This cadre would enroll in the civilian courses and design a course tailored to suit the needs of the unit(s) requiring the training. Such a cadre does exist and conducts this activity to a certain extent: CPC advanced mountain operators do attend civilian courses to maintain expertise in technical installations. However, due to CPC work load and focus on parachute instruction, the dissemination of this knowledge to the units that might be called upon to employ them is non-existent.

Full-Time Mountain Cadre and Army Mountain School. The creation of a full-time mountain cadre could fulfill the development of initiatives through a constant observation of new methods and technologies in the many related areas of mountaineering and rescue. To have such a cadre monitor the pulse of development would keep the CF abreast and perhaps even such a cadre to become a credible authority on safety and efficiency and a data resource for other government and civilian departments.

Within the CF, such a cadre could provide the training necessary for a special operations compatible (SOC) force. The cadre could be the link between the JTF2 and conventional forces to maintain the segregation of conventional and special operations forces. This cadre could conduct trials and evaluation on cold weather clothing and equipment due to the extreme environment in which they must operate. Furthermore, skills and methods of value to CF military mountaineering could be tested by those with a vested interest in and understanding of light forces.

A dedicated, full-time mountain cadre could become the core of excellence in all skills applicable to CF mountain doctrine. Skiing, alpinism, avalanche safety and use, tactics, caving, mountain and caving rescue and quad and livestock use would become hard disciplines, thus enabling CF mountain operators to be masters of their own domain. This cadre could also be viewed as a national and coalition resource for specific training, operations, expertise, and rescue.

The current centre of excellence for mountain training in the CF is CPC in Trenton, Ontario, which consists of AMO qualified personnel. It must be recognized that these personnel are double and, at times, triple tasked in areas other than mountaineering. Given the recognized importance of mountain operations to current CF commitments, it would seem more logical that a mountain cadre be located in the mountains with clear and focused objectives pertaining to military mountaineering requirements. A school set up and manned by a small cadre in the Canadian Rockies could be supported by 1 Area Support, for example, with the cadre belonging to CPC or Western Area Training Centre. This concept would be similar to the SAR school located at Jarvis Lake, Alberta (one hour away from Jasper National Park), except that it would need to be a full-time school in order to conduct seasonal training.

Budgetary climate is a major factor in this solution. The short-term price of establishing a dedicated cadre and school could be viewed as a channeling of resources to a very specific institution applying only to a

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limited number of personnel in the CF. A CF Mountain School and Cadre, however, could be a reliable asset to all elements in the CF, from pilots to naval ground liaison personnel to CSS personnel.

Canada's weather and geographical location already provide the CF with unique training opportunities. CF cold weather capability provides the platform for a high altitude mountain capability. Not only is the CF equipped and trained to fight in cold weather, it has the potential to do so at high altitudes. Inevitably, such a unique capability would shed international light on the CF and could create innovative contingencies for NATO and coalition planning.

The long-term benefits of this option are quite significant. Such a cadre could have changed the conduct of operations in Afghanistan. Prior instruction on the mountains of this region, the rock, techniques of cave entry and cave rescue, and the natural risks that caves present could have greatly augmented operational effectiveness. Commanders at all levels could have received instruction on mountain tactics and CSS and combat support personnel could have been better prepared for survival in this environment.

Another possible use of the cadre could be CF and cadet adventure training. The cadre could provide a subject matter expert to ensure safety and preliminary instruction for activities such as hiking and climbing. This cadre could also provide the nucleus for formation of a mountain unit if the requirement is deemed necessary in the future. Such a unit could also serve to challenge and develop the tactical problem solving abilities of leadership operating within this environment. This is something that has not been accomplished in the CF in a progressive way simply due to the fact that mountain exercises are infrequent and only challenge the existing leaders. In other words, unless regular exercises take place, the training is not progressive and leadership is not accustomed to the environment. Progressive training would be key to further development and special operations compatibility. Leaders who understand more about the shape, nature, and variability of battleground conditions will always have at least one significant advantage over a less-knowledgeable enemy.[20]

If disaster occurs in mountainous terrain, a permanently formed cadre could provide an immediate response, especially when civilian and other government resources are stretched to their limits. The initial benefit of such a capability is obvious—limiting the loss of life and material and maintaining Canada's faith in the CF. Perhaps this subject could be the focus of future investigation.

The evolution of the CF in the most recent decades has brought us technologically abreast and even ahead of many other armed forces from the First World. Obvious examples are the procurement of the ultra-modern fleet of naval vessels and the Land Force's procurement of the LAV III. These two projects are examples of our willingness to change in order to meet new threats and challenges. A relevant situation to this paper would be the recent extensive training in urban operations undertaken by the Land Forces to meet the strong possibility of urban centres being the next battlefield. The term "complex terrain" quickly became a common phrase. The methods of operating in an urban environment or mountain environment may require rope work and an alternate means of gaining the high ground. CF conventional and SOC forces require a skilled core of knowledge in these areas.

The methods of operating in an urban environment or mountain environment may require rope work and an alternate means of gaining the high ground.

As our military entered the millennium, our willingness to change in order to meet new threats and challenges was tested when the most extreme extent of Canada's foreign policy—war—was put into action. There is an ambiguous future ahead as Canada continues to uphold morality in her position against terrorism. In doing so, projection of this message may again take the form of CF personnel engaging in operations in any terrain. Will we be prepared as we should and can be?

ABOUT THE AUTHOR...

Sergeant Mike Gauley was first introduced to mountaineering at Banff National Army Cadet Camp in 1987. He joined the Regular Force in 1990 as a gunner and later served in The Canadian Airborne Regiment. Following a remuster to the infantry, he took the Advanced Mountain Operations course during the summer of 1997. In addition to the mountain exercises with the Army, Sergeant Gauley has maintained his passion for the mountains by climbing all over North America and in Europe, culminating in a 2001 ascent of Mt McKinley. Most recently, Sergeant Gauley served as a section commander in 3 PPCLI in Afghanistan, where his technical skills were relied upon in a tactical environment.

APPENDIX 1
RECENT CF OPERATIONS REQUIRING THE APPLICATION OF MILITARY MOUNTAINEERING TTP

Operation APOLLO. The 3 PPCLI Battalion Group executed this operation from early February 02 through July 02. During Operation APOLLO, numerous smaller operations took place, of which several were in the mountains.

The first and largest operation in the campaign against terrorism was Operation ANACONDA. This US Army-led operation was conducted in the Shah-e-Kot valley located in eastern Afghanistan. The Canadian Army deployed sniper detachments, which performed to very high standards, in support of US ground forces. Most of the snipers were qualified BMO. The Canadian battle group anticipated possible terrain challenges to be encountered by the American units assigned various tasks. A cadre of Canadian advance mountain operators was assembled to hold discussions, and they were ordered to prepare a training plan and possibly accompany the US Army sub-units on the operation as advisors. Training topics included mountain walking techniques, tactics, mountain ailments, and, above all, the effect of altitude on personnel. As events unfolded, the cadre's use was not seen as a priority to be scheduled into the battle procedure that was already taking place.

Operation HARPOON was the first Canadian offensive operation conducted since Korea. The task was to clear an entire mountain of enemy. Mountaineering consisted of non-technical skills such as mountain walking techniques and an awareness of altitude complications to the health of personnel. Mountain tactics were adhered to as the Canadians dominated the ground. Grouped with CF personnel were members of the U.S. Special Forces, who conducted sensitive site exploitation (SSE).

Operation TORI was entirely an SSE operation. It required pre-training on both technical and non-technical military mountaineering tactics, techniques, and procedures (TTP). Training included raising and lowering personnel and equipment into vertical shafts using rope hauling techniques. The operation relied on these skills to be successful. CF personnel were tasked to search and clear cave complexes and destroy them in order to deny their use.

Operation CHEROKEE SKY was conducted for several reasons. Among them, SSE. This operation involved searching cave complexes for enemy equipment and personnel. One phase saw CF personnel lowered into a deep cave complex located near the top of a mountain feature. Technical and non-technical skills were required for the success of this phase of the operation. Operation CHEROKEE SKY also saw CF personnel placed in blocking positions and high altitude observation posts (OPs) that required non-technical mountain skills.

These operations were dependant on the ability to operate competently in the mountains. The battalion group was centered around 3 PPCLI. It merits mentioning that due to the location of this battalion and the training opportunities seized by its commanders, this unit had been consistently training in the mountains for nearly five years. By the time the battalion was standing in the mountains of Afghanistan, it was not fighting the terrain; it was fighting the enemy in a familiar environment. Conditioning of soldiers in complex terrain bears some ownership of this mission's success.

Operation GRIZZLY. Operation GRIZZLY was conducted in the Kananaskis region of Alberta during the spring of 2002. Originally, the role for the CF during this operation was envisioned to be one of support only. The role of the CF evolved, however, and the partnership of the CF and the Royal Canadian Mounted Police (RCMP) became critical to mission success. The RCMP was able to broaden its area of security with the assistance of the CF. Both air and ground forces were involved in this particular area. The operation included ground force patrols and OPs, including air defence detachments.

Operation GRIZZLY was the biggest internal security operation in Canadian history, and CF involvement became critical to the success of the operation.[21] CF personnel, particularly in a light force role, were used to occupy high altitude OPs and patrol the "Blue Zone"(outer cordon). Preparatory training was undertaken by the units participating in this operation in the form of Exercise SOGDIAN ROCK. This exercise focused on the skills required for mission success and included terrain analysis, mountain hazards, common mountain miseries, mountain rescue, effects of altitude on helicopter operations, OP selection in mountainous terrain, rappelling, and fixed lines.[22]

OPERATIONS OTHER THAN WAR (OOTW)

Non-combatant Evacuation Operations (NEO). There are Canadian embassies, consulates, and/or high commissions in mountainous areas like Chile, Columbia, the Dominican Republic, Ecuador, El Salvador, Ghana, Guatemala, Guyana, Indonesia, Malaysia, Peru, Syria, Uruguay, Venezuela, and Brazil. If the security of Canadian nationals deteriorates to alarming degrees and evacuation is required, mountain trained troops may be required to provide assistance. There may also be a requirement to conduct NEO in locations where no Canadian embassies, consulates, or high commissions exist. This broadens the application of a mountain operational capability.

Assistance to Law Enforcement Agencies (ALEA). ALEA can be immediately associated with the G-8 Summit. Law enforcement agencies are not trained, equipped, or organized to conduct operations in non-populated areas.[23] This became apparent during Operation GRIZZLY and the subsequent reliance of police agencies on the military's unique skills.

Operation ELIXER. This was a counter-drug operation conducted in the fall of 1994. It was a joint CF/RCMP effort that involved CF ground personnel occupying OPs in mountainous terrain to monitor suspected routes used by drug traffickers.

Operation BLUE LINE. This is another joint CF/RCMP, counter-narcotic operation utilizing CF air assets to observe suspected airborne drug smugglers. This operation has a contingency where CF ground personnel may be used to assist in the recovery of narcotics dumped out of aircraft in an effort by smugglers to ditch incriminating evidence. The possibility exists that the evidence would be thrown from aircraft over extreme terrain features. The likely result of such

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an action would be that the material would have to be recovered in order to gather evidence for a trial and to safe guard the public from a harmful substance.[24]

Humanitarian Assistance. Humanitarian assistance is any action taken to save lives, prevent human suffering, or mitigate property damage. CF humanitarian assistance falls into three categories:

- civil disaster relief (natural or man caused);
- CF search and rescue (SAR), for aeronautical and maritime incidents within the Canadian SAR area of responsibility; and
- other humanitarian assistance.[25]

In recent conflicts such as the Former Yugoslavia and Afghanistan, a notable reaction for refugees displaced by fighting was to flee into the surrounding hills or mountains where they could not easily be pursued. The ability to properly deliver, distribute, and secure humanitarian aid into similar regions may require ground forces. Such a mission could be time-sensitive due to a seasonal change such as the approach of winter or a shift in conflict such as a hostile force's occupation of surrounding terrain. Such circumstances would limit preparation time for a humanitarian-aid response force.

Search and Rescue (SAR). As a supplement to existing SAR resources or when an incident occurs in such remoteness that no other resources are available than that of the CF, a capacity to sustain a prolonged SAR in mountainous terrain could prove invaluable. Such operations could extend to the recovery of sensitive material scattered or lost after the initial SAR of victims has been conducted. This concept can also be applied to the following:

- **Major Air Disaster (MAJAID).** in the form of immediate reaction to an aircraft forced landing or crash in the arctic, arctic mountains of Baffin Island, continental NWT, Yukon, or the Canadian Rockies in Alberta or British Columbia. The Canadian MAJAID contingency plan is solely dependant on the CF and may expand to include a catastrophic derailment of a passenger train in the Canadian Rockies, major avalanches in the Canadian Rockies in a populated area, on the Trans-Canada Highway, or on a railway, requiring a timely search on a grand scale, or an eco-tourism sea disaster involving a passenger ship near the remote northern arctic coast.
- **Contingency Operation PANORAMA.** This is the multi-departmental reaction to a major earthquake in British Columbia. Such an event could trigger other disasters such as avalanches of rock, snow, and/or ice in the routes through the Canadian Rockies that would, understandably, be congested with evacuees and rescue resources. Similar, but smaller, applications are the inevitable collapse of Turtle Mountain in the Crow's Nest Pass of Alberta due to frost-cracking[26] and combat search and rescue (CSAR) assistance of Canadian or coalition personnel in hostile territory.
- **Disaster Assistance Response Team (DART).** Currently, there is no mandate beyond a medical and fresh water response to Third World environmental disasters. As a supplement, a capacity to provide assistance, to some degree, in areas where volcano eruptions, mud slides, rock, snow, or ice avalanches, earthquakes, or other environmental catastrophes occurring in mountainous terrain would prove to be beneficial. Such a supplement could be limited to the attachment of a subject matter expert of mountain hazards to the existing DART as a safeguard to committed CF assets and personnel.
- **Allied Force Training Initiatives.** In order to continue the building of international partnerships among other armies, the CF could maintain positive relations through exchanges and training in mountain warfare.

ENDNOTES

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Meeting the Intellectual Challenge Posed by Synthetic Environment Technology

by Lieutenant-Colonel R.R. Bassarab, CD, and Dr. P.A. Roman, CD

In the science fiction novel *Ender's Game*,[1] author Orson Scott Card describes how a young boy saves the world. Andrew Wiggen, nicknamed Ender, has trained from his earliest days in various simulations of warfare and in the final battles. He leads the entire earth space fleet to victory while still believing that he is merely training in a distributed simulation system. In fact, at one point he complains that his tutors are being unfair because he believes they have programmed the computer (whom he believes is playing the enemy) to be too difficult for him. While elements of this story are farfetched, ongoing advances are daily contributing to a reality that is beginning to approach this situation.

During the last ten to fifteen years, the Land Force has witnessed a tremendous shift towards the use of specially developed simulation equipment to assist in training our personnel. At the Combat Training Centre in Gagetown, almost all initial weapons training, crew gunnery training, indirect fire control and driver training now includes the use of simulation equipment. The Weapons Effect Simulation (WES) project, now in implementation, will deliver a live simulation system (real soldiers and vehicles operating against each other in the field) including a fully instrumented battle group system for 2,800 players in Wainwright, Alberta and a non-instrumented combat team suite of direct fire WES equipment for 500 players in Gagetown, New Brunswick. A new unit, the Canadian Manoeuvre Training Centre (CMTC), in Wainwright will conduct WES training. Gagetown will use their WES systems in support of individual training courses run by the schools.

WES has a total capital and national procurement (NP) cost of $220 million. The contract includes all the capital equipment, communications infrastructure, and exercise control infrastructure, as well as ten years of contractor provided logistics support. The Army will pre-position all required vehicles in Wainwright, and soldiers will deploy onto the vehicles from their garrison locations across Canada. Units will be scheduled to attend CMTC as the pinnacle activity of their Army Training and Operations Framework (ATOF) Training Phase. Development of an Urban Operations Training System (UOTS) is also underway and has an estimated cost of $70 million for capital procurement and construction and $10 million in NP over ten years.[2]

Janus and the Command and Staff Trainer (CST) constructive simulations are used for collective training on staff courses and by the field force. The Army Simulation Centre (ASC) has been established and reorganized to include the Army Experimentation Centre (AEC). Funding has been approved to renovate the former Anderson Gymnasium in Kingston into a state-of-the-art ASC. In the Air Force, the Canadian Aerospace Synthetic Environment (CASE) project has been approved with definition funding of $1.5 million and an indicative cost estimate for full implementation of $45 million. Both the Air Force and Navy are planning to establish experimentation centres similar to the AEC. At the joint level, the Canadian Forces Experimentation Centre has been established along with a Synthetic Environment Coordination Office. This latter group is currently in the process of drafting modelling and simulation policy for the department. In Defence Research and Development Canada (DRDC) there is a new section dedicated to future force synthetic environment development, and the Assistant Deputy Minister (Materiel) Group (ADM [Mat]) has a new section dedicated to simulation-based acquisition (SBA).

The war fighter cannot accept the results from simulation on faith alone...

In the US Army, development is ongoing at an even greater pace. They have projects that are working on embedding training (and maintenance assistance) into every piece of equipment/system that they are procuring. Projects have commenced to harmonize their various computer generated forces (CGF) and semi-automated forces (SAF) software packages. Architectures, interfaces and other standards have been established in order to gain the most value out of the mass use of virtual, live and constructive simulations in synthetic environments (SEs). Changes to the Department of Defense acquisition policy (DOD 5000 series) are emphasizing the importance of simulation-based acquisition, requiring, for example, a simulation support plan as part of the overall project planning documentation. The Commanding General of US Army Materiel Command, General John M. Keane, plans to leverage the Army's version of SBA, Simulation Modeling for Acquisition Requirements and Training (SMART), to field threshold Future Combat System (FCS) capabilities this decade.[3]

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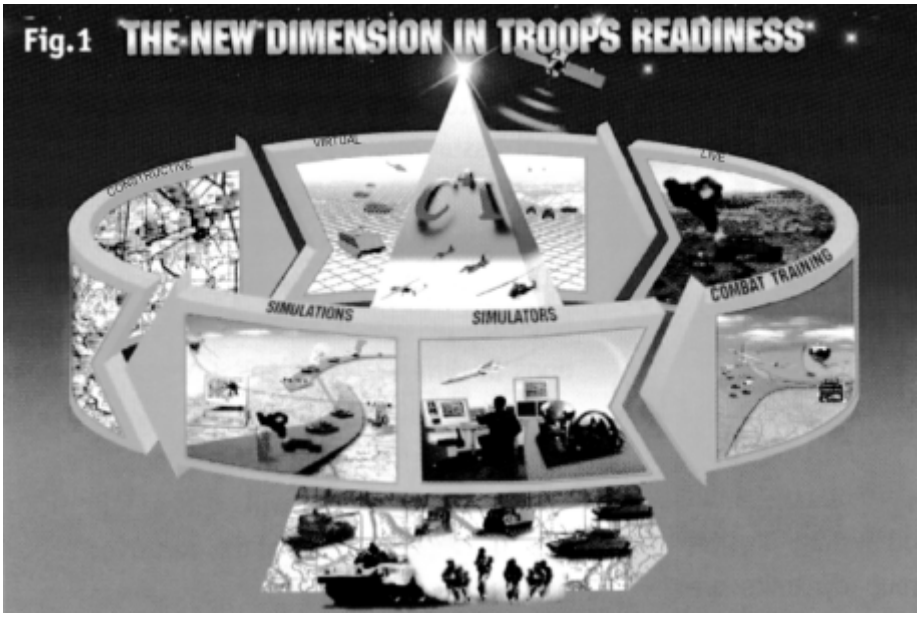

Figure 1: View of Training Using SE

It is the tremendous improvement in the capabilities of computers, and the key components inside them, which has facilitated this incredible growth in the military use of modelling and simulation. Complex synthetic environments now make it possible to do battlefield visualization, mission rehearsal, course of action analysis, concept development, experimentation, testing and employer of technology with adequate education to employ simulations intelligently, interpret results correctly and derive lessons learned appropriately.

THE ROLE OF THE SE IN FUTURE WARFARE

As the US military are generally considered as the current world leaders in the use of simulation and leveraging synthetic environments (SEs), it is useful to start with their vision of the role of the synthetic environment in future warfare. Figure 1[4] is a pictorial representation of how simulation in synthetic environments can assist in increasing readiness through better training. It illustrates the view that virtual, constructive and live simulations can all be linked into a coherent synthetic environment that maximizes the value of training and maximizes troop readiness. Although this diagram relates only to the training domain, the US vision[5] includes the use of Simulation and Modeling for acquisition, Rehearsal and Training (SMART). In fact, their vision of the role of the SE in future warfare goes well beyond just SMART. They are striving for a coherent distributed synthetic environment across all domains, linking live, virtual and constructive simulations. Software is being embedded in all weapons, platforms and equipment so that training can be conducted anytime, anywhere. Course of action analysis tools are being incorporated into operational hardware/software and distributed mission rehearsal capabilities are being developed. Simulation support has even been incorporated into both force projection and force sustainment activities.

Though perhaps not quite as comprehensive, the view espoused by the leadership of the Canadian military is similar. The Future Army Development plan of 8 March 1999 highlighted the need for war-gaming and experimentation to validate future army concepts. Operational Research and experimentation have played a key role in determining the way ahead for our transformation and for the interim Army structure. As already discussed, the Army has put considerable money and effort into individual simulators for marksmanship training, crew gunnery training, indirect fire control, driver training, the establishment of the Army Simulation Centre (including the Army Experimentation Centre), and

What intellectual challenges are posed by SE technology and how should the Army best meet them?

capability acquisition. In fact, the military is daily assaulted by legions of salesmen, all of whom are offering "magic" tools that operate in a visually impressive environment to facilitate every component activity that we undertake. Are we acquiring valuable tools or merely purchasing expensive toys? The normal answer to such a question is that a tool is only valuable if the user has the knowledge and expertise (and/or training) to use it properly. So what are the intellectual challenges posed by the extensive exploitation of synthetic environments, and how do we prepare our people to meet them? Do we need to be smart consumers and intelligent users, or do the majority of us simply need the operational knowledge of our profession? The authors of this article suggest that the war fighter cannot accept the results from simulation on faith alone but needs to be an objective

now the WES system and the CMTC. Our future army is to have "increased agility."[6] This is to be done by moving to a "command-centric, knowledge-based doctrine that achieves integration of information with manoeuvre at lower levels and devolved decision making authority."[7] We too have been discussing Synthetic Environment Based Acquisition (SEBA). Assistant Deputy Minister (Materiel) has created a SEBA cell and our army is discussing SMARRT acquisition (the other R has been stated as being for Research or Rehearsal, depending upon the source).

The achievement of these goals will require new structures, new equipment and new training and professional development approaches. The proper use of the toolset afforded

by a coherent synthetic environment can greatly assist in this migration. There is one important area, however, which has received little investment to date: education in the effective use of the synthetic environment and the tools that it affords. This leads us right back to the primary issue addressed by this paper: What intellectual challenges are posed by SE technology and how should the Army best meet them?

THE INTELLECTUAL CHALLENGES

In order to understand the intellectual challenges, it is useful to start with some definitions. A model is a representation of any aspect of the real world. There are many definitions of simulation, normally dependent upon the intended purpose of the simulation. A useful broad definition adopted by the US military is "the implementation of a model over time."[8] At the opening of the Army Simulation Centre in Kingston, the following explanation of a synthetic environment was given:

> *A synthetic environment (SE) links any combination of models, simulations, people and equipment (real or simulated) into a common representation of a world. This construct thus covers all initiatives that seek consistency and concurrency across reviously discrete activities. SEs are important contributors in the search for improved operational effectiveness and value for money. They offer significant benefits for supporting equipment acquisition, mission rehearsals, training, doctrine development and decision making.*

Any synthetic environment is based upon one or more models of the "real world" (a large synthetic environment is based upon a collection of interrelated and sometimes interactive ones). It must never be forgotten that all models are based upon assumptions that are best thought of as approximations of reality. The degree to which they approximate reality is normally measured in terms of "fidelity" and/or "resolution." The US military definition of fidelity of a model is "the accuracy of the representation when compared to the real world."[9] Their definition of resolution is "the degree of detail and precision used in the representation of real world aspects in a model or simulation."[10] Of course, the military user typically wants very high levels of both fidelity and resolution. This results in very expensive solutions, many times with little or no gain in value depending upon the use of the simulation. Much work must still be done to determine optimum mixes of fidelity, resolution and system costs in achieving the desired outcomes of simulation use in a cost effective manner. Many less-than-high fidelity and resolution systems are very functional and effective. The main problem is normally user acceptance, particularly when the low or medium resolution is in the visual representation. Unfortunately, users are often more accepting (at least initially) of systems with better resolution, even if they have relatively poor fidelity. On the other hand, it does not take long for experienced users to discover the areas where fidelity is poor and to become dissatisfied.

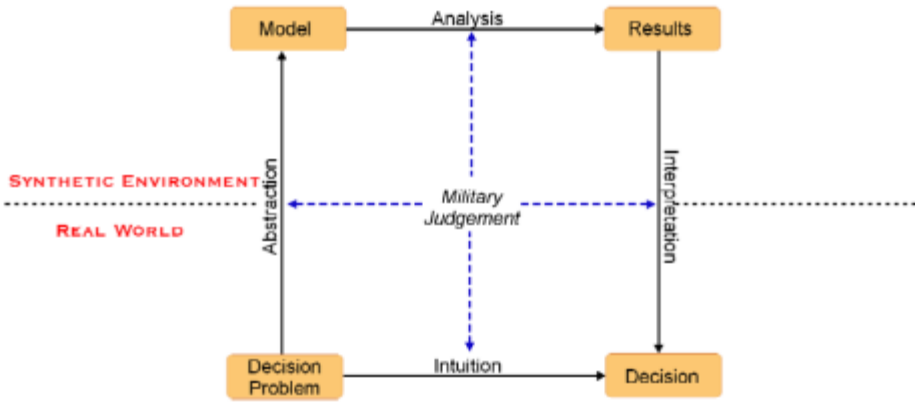

Figure 2: Role of Judgement in Modeling and Simulation

It has hopefully become evident that the fidelity and resolution of an SE depends upon that of the individual models that make it up. For example, a simulation of an engagement between two different tanks would require not only physical models of the two tanks but would also require models of the different ammunition types that each tank could fire as well as several other models. For low-level simulation, it is only necessary to have basic physical models of the tanks and a firing capability that can determine a hit/kill or a miss. In order to have higher fidelity in this simulation, it would be necessary to have good models for the flight ballistics of each ammunition type, the terminal ballistics of each ammunition type, vulnerability models for each tank, meteorological input and, if the tanks are moving, high fidelity terrain models and vehicle movement models. If any one of the models used in the simulation is inaccurate, the fidelity of the entire simulation/SE is reduced.

Figure 2[11] helps illustrate the role that judgment and experience has to play in the use of the synthetic environment. In each part of the process, the best results are achieved when expertise and experience gained in the "real world" are applied to what is developed and what is learned in the synthetic environment. It is often assumed that, when simulations are used as an aid to decision making, the simulation will tell you what the optimal solution is and therefore dictate what the decision should be. This assumption is **not** correct. The optimal solution exists only in the synthetic environment that was created by making abstractions about the real world. The results produced must then be interpreted because the decision problem exists in the real world, a place that is so complex and subject to random events that it is ridiculous to think that an optimal solution exists. Of course, the simulation should provide a better understanding of the key parameters and a feel for how sensitive the decision is to small changes in their values. However, there are insights about the problem that need to be taken into consideration along with the decision maker's intuition about

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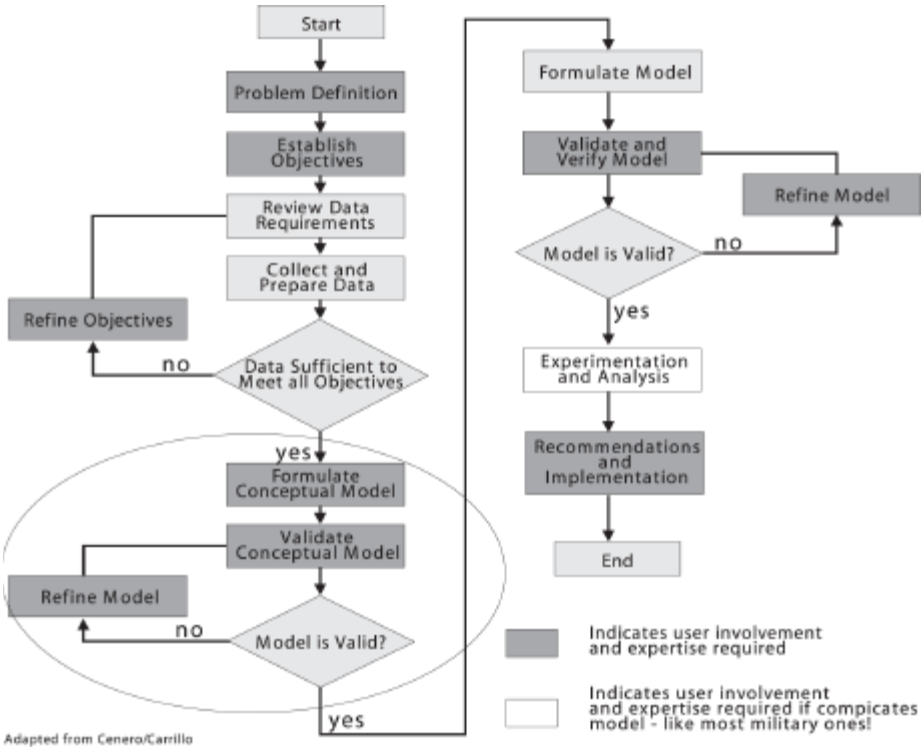

Figure 3: Simulation Process

the real world and a clear understanding of the limitations of the model and the analysis performed. As is indicated in Figure 2, the decision maker mixes this better understanding with military judgment to make what is hopefully a reasonable decision. A good example of this is course of action analysis during operations. The use of war-gaming is not simply to provide the commander and/or staff member with the "answer" as to which course of action to select. It is to provide the commander and/or staff member with a better understanding of the nature of the problem, thereby facilitating not only course of action selection, but also knowledge of what steps need to be incorporated into the plan to obtain the highest chance of success with the course of action chosen. The developed plan can take into account all of the key parameters that became evident as a result of the war-gaming, but it is the commander (and staff) that makes all decisions and plans utilizing the insights gained in the SE.

Figure 3[12] is a more detailed illustration of the process required to conduct any type of simulation, whether it be an aid to decision making in a traffic flow problem or something like the LAV instrumented field trial. It highlights all of the steps where involvement is required by either the decision maker or a system expert, regardless of who conducts the actual simulation and in what manner that simulation is conducted. Problem definition is akin to mission analysis. Specialists and/or contractors may lead this step, but without personnel who understand the real world situation that is being modelled, it is likely to put the entire simulation at risk of failure. The same is true for the establishment of the objectives of the simulation. Simulation experts may indicate where the tools available cannot, or will have problems to, achieve the desired objectives, but subject experts must make decisions on objectives.

Achieving the specified objectives will primarily depend upon how well the model is developed, verified and validated. Validation first occurs after the formulation of a conceptual model. Conceptual models take many possible forms from a simple process flow chart (like Figure 3) to physical models or spreadsheet representations of problems. A conceptual model lays out the blueprint for the simulation that is to be developed. Validating the conceptual model ensures that the correct thing is modelled before any serious development work is undertaken. Based upon a shared understanding between the model developer and the decision maker responsible for its validation, the simulation model can then be formulated or programmed. Increasingly, this step involves the use of a simulation framework using a tool such as Janus or OneSAF.[13] Verification is the process whereby the modellers ensure that the model is programmed correctly. However, even if the programming is bug free, the model still may not be valid for the purpose described in the objectives for the study. It is crucial that the decision maker is involved at this step to ensure that the simulation model is fit for its intended purpose. The mini loop involved with a conceptual model (the portion circled) is not always required, but in more complex situations it can save a great deal of time, money and effort. Once the model or models are validated and verified (and sometimes accredited or certified depending upon user requirements) actual simulation and/or experimentation is conducted and the analysis completed. Any recommendations must take into account model imperfections—**all** models, as limited representations of the real world, are imperfect. Of course, this can't be done effectively if the imperfections are not known and understood. For this reason it is often important that there be some SME representation and involvement in the experimentation and analysis step if the system is a complex one.

It is critical that personnel who are identifying lessons learned are aware of all of the shortcomings of the synthetic environment.

It must be remembered that the concept of an SE is that many different uses will be made of that environment. This requires the development of a detailed SE with a very large number of interrelated and interactive models. Not each component model will be required in each use of the SE. However, to gain the most value from the many varied uses of the SE, it is essential that each component model be reusable in many different scenarios. Even more importantly, if data from different uses of an SE are to be compared or reused, it is essential that they be based upon the same or very similar models, even though individual users may not consider it essential for their single use. It is necessary to establish architectural standards, interface standards, consistency in geodesic representation, etc. if use of the SE is going to produce consistent results that can be compared and reused. This is critical if SEBA is fully implemented. On the positive side, the introduction and use of these standards can greatly simplify the overall validation, verification and accreditation (VV&A) process.

Simulation users and developers (as well as the people who analyze the results and make decisions) must understand the strengths, weaknesses, gaps, etc. in all of the models that make up the SE they utilize. In some circumstances this knowledge may be transparent and relatively unimportant to the user, but in many others it will be critical to the proper utilization of the SE and the results or lessons learned that are gained from its use. Failure to incorporate architectures, standards and authorities can lead to many problems. For example, in "training" applications of simulations such as Janus, it is sometimes beneficial to the training aims of a given exercise to alter the normal parameters of some of the weapons or vehicles involved. While this frequently helps achieve specific training aims, it must be understood that any data gained from that exercise could not be reused for analytical or other purposes as the base models were altered. Care must also be taken to ensure that the personnel under training are not learning incorrect lessons. It is also critical that personnel who are identifying lessons learned are aware of all of the shortcomings of the synthetic environment being used. Another example came out of the instrumented LAV trial using the US Mobile Automated Instrumentation Suite (MAIS). A review of the data initially led to a possible conclusion that all anti-tank missiles were virtually ineffective against the LAV III. Upon further review, this lesson was modified. The missiles "appeared" to be ineffective because in the SE used they were simulated using a laser beam for the entire flight time. This gave LAV crews, with their laser warning receivers, an advantage that only exists for those anti-tank weapons that are laser guided. Thus, it is correct to deduce that the laser warning receiver on the LAV increases survivability against laser guided anti-tank weapons, but it would be incorrect to deduce that the same applies to all anti-tank weapons. In this example it is reasonably easy to ensure that an incorrect lesson is not learned, but in many cases the circumstances are more subtle and are only picked out by experienced operators with a thorough understanding of the SE being used.

MEETING THE INTELLECTUAL CHALLENGES

Challenge 1—Education

It was mentioned earlier that the US appear to be the world leaders in military use of the SE, so it is useful to see what they are doing in this area. For several years, the US Modeling and Simulation (M&S) Master Plan has included a strong education component. One portion of their education program is the US M&S Officers' Course, which is a one-week course conducted at different times and geographic locations across the US and around the world where US troops are deployed in large numbers. Another portion is the strong curriculum content at West Point, including undergraduate degree programs in both Engineering & Management and Systems Engineering. The US Army/DoD also holds multiple annual seminars and symposia related to military use of the SE. Post-graduate degrees in modelling and simulation are currently offered at three locations in the US: the US Naval Post Graduate School, the University of Central Florida and Old Dominion University. The US Chief of Staff of the Army, Gen Shinseki, believes so strongly that the requirement for experienced operators to also be educated in the use of M&S/SEs that he created a new MOC. The MOC, FA 57, is designed to develop officers who are "equally adept as an operator and simulationist."[14] His vision is "by the year 2005, to produce a talented group of officers who have developed both as operationalists and simulationists, who are competitive for battalion and brigade level commands, who are potentially capable of helping design/create the enhanced simulations environments that will generate a training revolution by 2015."[15] By these quotes it is obvious that the US Army wants their "simulationists" to be top-level experienced operators with excellent chances for career progression.

What do we require in the Canadian Army? Certainly, we cannot create a separate MOC, nor can we put an unnecessarily large burden on our developing and expanding professional development programme. First and foremost we need to develop, publish *and implement* Army and DND level M&S or SE master plans. This should include a two pronged approach regarding training/ education. The first prong would be to increase general awareness and understanding. All personnel should be taught more about simulations and use of the SE. This includes understanding that all models are imperfect, that they have strengths and some weaknesses. Time should be taken to point these out when using any given simulation. This will help ensure that maximum value is gained and bad lessons are not learned. Personnel should also be taught to understand at least the basics of probability and statistics and how they are employed in simulations.

The second prong would be the development of more advanced specialist professional development

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for selected personnel. Some obvious candidates for this training are simulation and experimentation facility staff, central and service simulation staffs, project directors and project managers. Perhaps less obvious, but just as important, are force developers, future's groups, training centre staff, educators, acquisition staff and even doctrine and training writers. It will not be possible for every one on all of these staffs to receive specialist training, but if a reasonable portion do receive it, the others will gradually absorb the key elements. Some specific steps include:

- Sponsorship on specific M&S courses (like US M&S Officer Course)
- Encouraging undergraduate degrees in related subjects
- Emphasizing Engineering Management at RMC
- Encouraging attendance at relevant seminars and symposia
- Supporting post-graduate related courses at RMC—this has started—and elsewhere
- Increasing M&S curriculum at the Land Force Technical Staff Programme (LFTSP)—this started with LFTSP VIII in 2002
- Increasing M&S curriculum at the Canadian Forces Command and Staff College (CFCSC) Toronto

The next aspect to look at is what should be included in this advanced education/training? This has been the subject of much debate amongst professional educators. Their debate has centred on not only what should be taught but also at what level—normally referring to the choice of undergraduate or post-graduate levels and which department (within the university) should sponsor the courses. Although the debate continues to be a heated one, there is general agreement[16] that the following topics must be included:

- Statistics and probability theory
- Basics of modelling
- Monte Carlo techniques and random numbers
- Simulation process
- VV&A requirements and techniques, especially validation
- Role of modelling and simulation in aiding decision making

In the military context it would be important to add the following:

- Military M&S domains and use of SE in each one
- Introduction to the available M&S/SE toolset

CHALLENGE 2—CREATION OF A COHERENT SYNTHETIC ENVIRONMENT

Many of the goals that have been discussed are very much dependant upon the existence of a coherent synthetic environment. How are we to achieve this in Canada? Some of the necessary key steps have recently been started. These include the establishment of agencies responsible for coordination, standards decisions and guidance, establishment of protocols and architectures. The Army has established the Army Simulation Centre (ASC) and is establishing a Synthetic Environment Coordination Office. The CF has established the Canadian Forces Experimentation Centre (CFEC) and a Modelling and Simulation Coordination Office. Defence Research and Development Canada has established a Future Forces Synthetic Environment Section. Assistant Deputy Minister (Materiel) has established a SEBA group. However, there is still no published master plan and little glue to bind all of our efforts, although there have been some tri-service working group meetings where key issues have at least been discussed. With all of these various efforts underway, it is vital that master plans not only be written but also implemented at DND and Army levels. Any additional delay will not only cause additional effort and expense but could jeopardize the successful creation of a coherent SE.

There is a strong need to establish responsibilities for the validation, verification and accreditation of the different models and simulation tools that we use. This should include the establishment of authoritative agencies who are responsible for certain types of models. In the US Army there is one group, the Army Materiel Systems Analysis Agency (AMSAA), who are responsible for all weapons and weapons effects models. It is doubtful that we could afford to have one such large central agency, so it is recommended that responsibility be spread out to different locations. For example, weapons, ammunition flight ballistics, etc. could be the responsibility of DRDC Valcartier, while communications and EW could be the responsibility of DRDC Ottawa. Certainly Director General Operational Research (DGOR) also has a strong role to play in this area; perhaps they would be the overall coordinators and holders of master model data. Alternatively, each of the services could establish repositories of data and models that have been verified, validated and accredited for specific purposes but shared across the

There is still no published master plan and little glue to bind all of our efforts.

services to help meet specific requirements. Whatever the final allocation is, it is essential that these responsibilities be allocated soonest so that our development of a SE is done in a coordinated and coherent manner.

CONCLUSIONS

The military use of M&S and SEs has been rapidly expanding and it offers an array of tools that promise to assist in the achievement of our goals and our missions. However, in order to achieve these benefits, it is necessary that we provide our personnel with the appropriate training and education so that the tools are used properly. It is not sufficient that we be merely uneducated end-users of these tools. The use of M&S and an SE does not in itself provide a panacea that will remedy all our ills and shortcomings. If we are not involved in their development, if we do not understand and factor in their shortcomings and limitations, if we do not learn the appropriate mixes between "live" and "simulated," between "generated statistics" and "applied military judgment" and between "one possible outcome" and "factors and parameters that will most affect the outcome," we will merely be buying expensive toys. In the final analysis, it will be our knowledge, understanding and employment of "synthetic war" that will ultimately determine how well we take advantage of this technology.

ABOUT THE AUTHORS

Lieutenant-Colonel Rusty Bassarab received a B.Eng degree in Engineering and Management from The Royal Military College of Canada in 1975. In addition to formal Canadian staff courses, he attended Division I of the British Army Technical Staff Course at the Royal Military College of Science in Shrivenham, Wiltshire. His military service has included five regimental tours, two UN deployments and two domestic operations. He spent four years as the Canadian Liaison Officer to US Army Material Command. During that time, he completed the US Army Modeling and Simulation Staff Officer's Course and had lead responsibility for modelling and simulation coordination between the two armies. Lieutenant-Colonel Bassarab is currently one of the Directing Staff for the Land Forces Technical Staff Programme that is conducted at RMC.

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ENDNOTES

1. Orson Scott Card, *Ender's Game*, (New York: Tom Doherty Associates, 1994).
2. For further info on WES, please visit the WES pages at this URL: http://www.forces.gc.ca/dless/wes/main_e.html
3. Gen Keane made these comments in December 2002 during a presentation to the Army's 23rd Science Conference held in Orlando Fla.
4. K. Shmuel, "LeveragingTraining Infrastructure to Enrich Training," *MS&T Magazine*, Issue 2 (2002), p. 26.
5. The US vision stated is not based upon any specific source. It is based upon the author's experience of four years as the Modelling and Simulation Thrust Leader in the US based CFLO organization, including attendance at multiple symposia, the US M&S Staff Officers' Course, and the US M&S Education Working Group.
6. LGen Jeffery, Chief of the Land Staff, Presentation to Army Council, Apr 2002.
7. Ibid.
8. Department of Defense 5000.59-M, *M&S Glossary*, January 1998, p.157.
9. Ibid, p. 112.
10. Ibid, p. 153.
11. Adapted from Eppen, Gould, Schmidt, Moore and Weatherford, *Introductory Management Science* (Prentice Hall, 1998), p. 5.
12. Adapted from Centeno & Carrilo, *Challenges of Introducing Simulation as a Decision Making Tool*, 2001 Winter Simulation Conference, Figure 1.
13. The US Army OneSAF program is aimed at replacing all currently used constructive simulations for use at brigade and below. The first tool in this program was ModSAF, which has been replaced with the OneSAF Testbed currently in use at the Army Expermentation Centre and some Defence Research and Development Canada locations. The OneSAF objective system should be available in Canada starting in 2005.
14. US Army Model and Simulation Office website (www.amso.army.mil), *FA 57 Professional Development Requirements, Philosophy and Method*, 27 Nov 00.
15. Ibid.
16. This is based upon a synthesis of the following papers presented at the 2001 Winter Simulation Conference: Crosbie, Zenor and Hilzer, *More On A Model Curriculum for Modeling and Simulation*; Nance and Balci, *Thoughts and Musings on Simulation Education*; Altiok, L'Ecuyer, Schmeiser, Schruben, Kelton, Nelsol, Schriber and Wilson, *Various Ways Academics Teach Simulation: Are They Appropriate?*, Panel Discussion on Education in Simulation.

Breaking from the Past

A Primer on Army Digitization

A Special Feature of the
The Army Doctrine and Training Bulletin

With the introduction of digitization, the Army will experience revolutionary change in command and control. The technical, doctrinal and structural changes will be breathtaking, and we must all be prepared to ensure that truly enhances our warfighting capabilities. This feature will examine the more practical aspects of digitization and the changes that are about to come.

The Advent of Digitization

A Doctrinal Perspective

by Lieutenant-Colonel R.L. Bowes, CD

In the two decades before 1914, the principal technological challenge faced by the leading armies of the day was coming to grips with the ascendancy of firepower on the battlefield and the supreme difficulty, as Basil Liddell-Hart coined it, of crossing the fire-swept zone.[1] Both the Anglo-Boer War and Russo-Japanese War demonstrated that the magazine rifle and smokeless powder made frontal attacks more costly, that cavalry attacks with sabres had become suicidal, and that the power of the entrenched, barbwire protected defensive position had rendered the frontal attack unprofitable.[2] It gradually became evident that technological changes had rendered the defensive much more powerful than the offensive. Yet, the response to the challenge of firepower at this time was moral rather than technical, and certainly not doctrinal. More to the point, it was a response that further entrenched and solidified legacy and contemporary offensive doctrine in the face of technological change.[3] European armies generally accepted the first part of the firepower equation—that new weapons and technology had rendered the battlefield a very deadly place—but could not accept the second part of the problem—that tactics and doctrine, accordingly, must change.[4] Instead, from a doctrinal perspective, and despite some contemporary debate to the contrary, these armies generally chose to defend traditional mid-19th Century doctrinal offensive concepts, and sought to overcome the overwhelming destructive effects of the machine gun and artillery by placing a higher degree of confidence in the shock effect of the massed, bayonet-fixed, shoulder-to-shoulder frontal offensive; and in the moral and psychological qualities of the individual soldier.[5] However, the secret of success on the Western Front in the First World War was indeed, to be found in doctrine. For the French and British armies, the formula for success came in a method that favoured *mechanical* warfare, but also considered the infantry to be the ultimate means of holding ground and achieving victory. The champions of this method advocated a mastery of low-level infantry tactics, a de-centralized command philosophy, the successful pioneering of tank-infantry cooperation, the solving of some of the many problems associated with sustaining artillery support throughout the depth of the assault, and, above all, the resurrection of the tactical principle of surprise.[6] Similarly, the Germans took advantage of the new weapons of trench warfare—light machine guns, trench mortars, grenades and gas—to pioneer, again, low-level infantry infiltration tactics that allowed them to achieve tactical and operational surprise and break through allied defences.[7]

The point is that the introduction of new technological capabilities has always posed a challenge to existant doctrine and to the contemporary understanding of the optimal conduct of battle and war. The experience of the First World War is but one example of the axiom that the key to fully exploiting technology, and the key to adjusting to the threats posed by the introduction of new technologies by one's adversaries has ultimately been doctrinal evolution and tactical innovation.[8]

Today, the same axiom can be applied to digitization—the application of information technology for the acquisition, processing and distribution of digital information to enhance situational awareness and operational effectiveness. The common belief is that digitization will be the most important technological advance to effect military operations for the next twenty years. Digitization promises to: automate and shorten the military decision-making process for commanders; link a variety of sensors, manoeuvre and fire delivery platforms; link all battlefield operating systems and common databases with secure high capacity communications; and, greatly assist in providing situational awareness and battlefield visualization. By 2020, portions of the armies of many major developed nations will be trained and equipped to conduct non-linear, simultaneous operations aimed at disintegrating the enemy's ability to wage war.[9] In turn, digitization will also serve to increase the lethality and dispersion of weapon systems, increase the volume and precision of fire, increase the mass and effects of munitions, and improve the visibility and detectability of the enemy.[10] Finally, within the Canadian context, the Army sees digitization as a key capability that will allow it to modernize and evolve into the Army of Tomorrow.[11]

the intro of…New technological capabilities has always posed a challenge to existant doctrine and to the contemporary understanding of…war.

From an historical perspective, digitization provides us with an unprecedented opportunity to break down the stovepipe information structures that have characterized armies throughout the ages. As well, it provides us with an unprecedented ability to move large amounts of information to a wider audience at greater speed and in more flexible formats. This means that information that traditionally flowed vertically from one command echelon to the next because of system hardware and/or organizational process limitations, may now be accessed by a greater number of users spread vertically *and horizontally* across an organization. Thus, the requirement for formal collation and dissemination of information at each successive level is negated, provided the underlying data is somewhere in the system and can be accessed universally.[12] Thus, the staff effort can be more exclusively focused on knowledge management (what does the information mean?) in order to better support a commander in his/her ability to plan and make decisions. But, what does this mean tactically? In its

simplest form, it means that commanders and soldiers can instantaneously and continually better answer the three questions that have confounded them throughout the history of warfare: *Where am I? Where are my buddies? Where is the enemy?* Moreover, because of the data-centric nature of digitization, the information to answer the above questions is shared throughout an organization thus creating, it is believed, a heretofore-unprecedented ability to achieve a higher level of shared situational awareness and situational understanding in the minds of commanders and soldiers. Digitization does not equate to the sum of the various systems employed, but is an exceptional combat or force enabler. As a result, digitization offers a means to remove a significant amount of the uncertainty associated with land combat, which, in turn, has a profound impact on the tactical command of land forces in terms of the commander's confidence and operational tempo.

It is becoming increasingly clear that confidence in the minds of commanders is the primary factor leading toward a larger or extended area of operations. The production and dissemination of accurate, timely and relevant information and knowledge, engenders not only shared situational awareness and understanding among commanders, staff and soldiers, but also confidence in the minds of commanders throughout an organization. Moreover, the integrated nature of digitized command and control information systems (C2IS) means that very little data and information is analogue, thus reducing input and accuracy delays in processing. Thus, commanders are confident about the timeliness and accuracy of the information presented to them. While digitization will not wipe away the fog of war, and realizing that they are still going to need to apply judgement in the assessment and validation of information and knowledge in order to produce a coherent and believable level of understanding of the situation, commanders will be, nonetheless confident about where their forces are, confident about the terrain and other elements of the operating environment, and confident that they know where the enemy is as well as its strengths, weaknesses and intent. Subsequently, this confidence, when related to their understanding of higher commander's intent, allows commanders to make rapid and effective decisions at the level appropriate for those decisions to be made, i.e., mission command is further enhanced by the advent of digitization. Confidence also allows risks to be taken with respect to force deployment and employment, thereby allowing manoeuvre forces to disperse to greater distances but concentrating only at decisive points, leaving flanks and rear areas less guarded physically than in the past, and relying more on the concentration of pre-emptive fire rather than manoeuvre for security. If they can see farther than the enemy, decide faster than the enemy, and act (manoeuvre supported by fire) quicker than the enemy ("see first, understand first, act first"), then they can operate over wider and deeper areas of operations than in the past. In fact, digitization allows the luxury of choosing where and when to fight, to seize, retain and exploit the initiative, and to vastly increase operational tempo thereby allowing the more efficient use of time than the enemy, and creating a greater amount of uncertainty, shock and fear in the minds of the enemy commanders and soldiers.

Digitization, to quote Robert Leonhard, "will allow us to move ten times faster than before."[13] The synergy created by the manner in which the technologies associated with digitization combine offers a commander the ability to both accelerate decision-making and make it more accurate and reliable. This ability, in turn, will naturally drive more rapid, efficient and effective execution. The grounds for this observation are quite simple.[14] Firstly, digitization brings digital mapping and position location information for every fighting platform on the battlefield thereby reducing time lost due to friendly forces becoming lost or disoriented. Moreover, the possibility of quickly manoeuvring significant forces through traditionally slowing terrain (undulating desert, trail networks in forests/jungle, urban terrain, etc.) greatly increases the options available and the scope for achieving surprise. Secondly, the integration of C2IS with the information on enemy positions, activity and intent provided through Information, Surveillance, Target Acquisition and Reconnaissance (ISTAR), allows friendly forces to much more readily base their manoeuvre and movements on a risk assessment of where the enemy is (or is not) and what it's doing. Friendly commanders need not, therefore, waste precious time with operations to secure flanks, defiles or crossing points, and need not conduct offensive or defensive operations against reports of enemy forces that later prove to be false. Moreover, greatly improved situational awareness with respect to the enemy gives friendly force commanders the ability to use resources more economically, to greater effect, and concentrated on the main effort. Thirdly, with positional and control-oriented information being transmitted via data transmission, voice combat net radio frequencies are now reserved almost exclusively for command purposes. This means that the ability of commanders to continually develop and maintain a shared understanding of the situation and a shared understanding of commander's intent is now better than ever. Supported as they are with the situational awareness provided through digitized C2IS, commanders will undoubtedly be able to plan and make decisions at an unprecedented speed. Indeed, to not take advantage of this capability risks wasting valuable time and consequently reduces the chances of achieving and maintaining a higher operational tempo than the enemy's. A higher operational tempo creates chaos, shock and fear in the minds of the enemy commanders and soldiers. It follows, then, that the greater one's operational tempo over that of the enemy, the greater chance one has to pre-empt, dislocate and disrupt an enemy and achieve surprise,[15] and thus sow the seeds for its defeat. Having a higher operational tempo than that of the enemy means that one can conduct more effective and less risky operations in order to pre-empt, dislocate and disrupt, and it means that we can choose the time and place to fight in a simultaneous manner, thus generating an overwhelming situation for the enemy.

So those are the promises, …but will they be realized? Certainly, the data-centric focus of digitization in which the many information- handling tasks associated with the command, control and administration of tactical land forces during operations become automated processes is a major step toward achieving these promises. However, data-centricity does not, in itself, guarantee improved situational awareness and shared situational understanding. In other words, simply grafting the technology onto our current command

and control processes and structures will not necessarily guarantee the force enabling potential of the technology. Indeed, observation of some of the early force development activities being conducted in Canada and other nations has confirmed that there are two principle challenges or threats now being posed by the introduction of digitized C2IS to the *status quo* command and control processes and structures. First, it is becoming increasingly obvious that the opportunity for achieving a faster operational tempo that serves to overwhelm an enemy will depend on the ability of a command system to capitalize, in a timely manner, on the much-improved situational awareness that digitization brings. However, it has also become obvious that the cognitive and analytical planning and decision-making functions of human commanders and staffs have now become the determinant of the time critical path of the decision-action cycle. In other words, our legacy planning and decision-making processes and procedures are too slow to fully take advantage of the opportunities presented by the technology and increase operational tempo. Second, it is also very obvious that, if not employed properly, digitization could easily engulf a command and control system with a vast amount of data and information, so much so that the command and control system is paralysed.[16]

If not employed properly, digitization could easily engulf a command and control system with a vast amount of data and information...

So how can doctrine evolve to fully capitalize on the advantages offered by digitization and avoid the threats as described above? Focussing on the commander's confidence and higher operational tempo and the need for commanders to balance the reduction of uncertainty with the pace and tempo of operations, it is clear that a first principles examination of extant doctrine is required to determine those processes, procedures, philosophies and organizational structures that could potentially impede the full realization of what digitization promises.

Firstly, planning and decision-making should be studied. It is now commonly recognized that there are two basic ways to make decisions. The analytic approach, a primarily staff driven approach, aims to produce the optimal solution and emphasizes analytical reasoning processes guided by experience. The other method, the naturalistic approach, is the act of making a decision that emphasizes recognition based on knowledge, judgement, experience, education, intellect, boldness, perception and character. The naturalistic approach is much more of a command-centric approach, which replaces methodical analysis of options with assessment, obtains a satisfactory solution rather than an optimal one, and uses analysis to refine the decision. One approach is not better than the other. Moreover, all decision-making contains elements of both approaches. The analytical approach still relies on the initial naturalistic understanding of the problem by the commander as part of his commander's planning guidance. Similarly, the naturalistic approach will rely on the analysis of certain parts of the plan or in selected staff checks in order to refine the plan. However, the key determinant as to what approach to take, and here is the main point, is the time-uncertainty conundrum. Throughout history, the quintessential challenge for commanders has been the need to balance the reduction of uncertainty with the pace and tempo of operations. However, the irony of digitization is that as the level of uncertainty is being reduced through the provision of timely, accurate and reliable information and knowledge (commander's confidence), increasing the ability to make more informed and better decisions, the pressure to make decisions in less and less time is also increasing. Therefore, digitization has altered the respective weightings of the time-uncertainty dichotomy. Time is now the key factor in the digitized execution of operations. Accordingly, there must be a more formal doctrinal recognition of the value of the naturalistic approach to decision-making. To be sure, current command doctrine does indirectly recognize the naturalistic approach through recognition of intuition as one of the qualities that commanders must possess.[17] However, it is the contention of this paper that, in a time-constrained environment, the naturalistic approach must be formally recognized as a valid and command-centric method of decision-making. Formal recognition must also be coupled with a new approach to our current understanding of decision-making processes.

In current doctrine, the only planning and decision-making process that is envisaged as having a real utility in a time-constrained operating environment is the combat estimate, backed up by some staff/advisor assistance depending on the level of command (section to battle group). It is the contention of this article that the doctrine, as stated, is sound. However, at the brigade group level, the tasks given to a brigade group are apt to be of such a degree of complexity that a combat estimate conducted solely by the commander will more often than not be impractical; he would need staff assistance. Conversely, it is also the contention of this paper that having the brigade staff conduct a full operational planning process (OPP) would also be unrealistic during the extremely time-constrained, high tempo execution phase of operations that digitization heralds. Even with the most experienced and best-trained staff assistance, conducting a full OPP cycle would take too much time and would risk having the decision-action cycle of the brigade fall behind that of the enemy. Therefore, in the interests of making timely yet effective decisions at the brigade group level during the execution phase of operations, the “tools” or toolbox analogy, presently used for describing battle procedure and the combat estimate must be extended to OPP. While the present *Command* manual acknowledges that in most operational situations, battle procedure will be compressed and/or adjusted due to time constraints, this recognition is not necessarily explicitly connected to OPP, it is only implied. This evolution of doctrine is tailored to situations in which uncertainty may be at an acceptable level, but because of the pressures to maintain a high operational tempo, full OPP is not feasible because of the lack of time; situations that could become more

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frequent in a digitized command and control environment. It capitalizes on the naturalistic decision-making skills of the commander while benefiting from the analytical skills that the staff would bring to the problem.

Second, is the problem of data and information overload. Ideally, the most crucial elements of information required by a commander should be those that help the commander communicate and express his intent, and those that directly pertain to the ability of a commander to realize his intent.[18] With the volume of data and information that a digitized C2IS will be able to produce, it is obvious that a commander's expression of commander's critical information requirements (CCIR) at the beginning of, and throughout, an operation is of paramount importance. While CCIR are not new to doctrine, their importance have now taken on new proportions in the digitized command environment. Of prime significance during high tempo situations will be the requirement of commanders and staffs to continually assess the execution of operations against his intent and original visualisation of the battle. Thus, commanders will have to continually re-affirm or amend their CCIR during the execution of operations. CCIR are defined as the crucial elements of information identified and required by the commander that directly affect decision-making and successful execution of operations. Without them, a commander and staff's ability to discern relevant knowledge and visualize the way ahead would be at risk. They provide a focus for the headquarters information collection activities and prevent irrelevant details from concealing the critical essentials. Indeed, CCIR will bind and discipline the information management processes and functions within a unit or formation. In answering CCIR, three aspects of digitization warrant the most attention in terms of system and doctrinal development: establishment and maintenance of a common operational picture (COP), the vital and inextricable link to intelligence/ISTAR products and processes, and the establishment of efficient and relevant information management processes, procedures and structures. Indeed, as the Army continues with its digitization efforts, if these three aspects of digitization are not developed properly, the fielding and implementation of digitized C2IS will not prove to be the force enabler it is promised to be.

The COP is a representation of operations that can be tailored by users, based on common data and information shared by more than one command. It facilitates operational planning and assists all echelons to achieve situational understanding. In practical terms, it means that regardless of level of command a commonly shared enemy picture can be displayed on a single screen juxtaposed with shared friendly force positional and situational information on a shared or common map product. The key here is the sharing of a timely, relevant and accurate common database that all can draw upon in order to display identical information to the degree of granularity required for their respective function, task or mission. Doctrine and relevant operating procedures will need to reflect the importance of the establishment and maintenance of the COP throughout all command echelons. Clearly, each commander's COP picture may differ somewhat based on command requirements. However, what army contingents will need to gain with the COP, more than informational superiority, is a **knowledge advantage** on the enemy. To guarantee this we must offer our contingent connectivity to higher intelligence and information, with reach back systems, as well as training, education and experience that ensures that each soldier can use the information provided, and has the freedom to act according to his COP. The unprecedented force enabling aspect of the COP is that for the first time in the history of land warfare, disparate commanders and staffs have a common artefact upon which to reach a common and shared cognitive understanding of the tactical situation. The data-centric nature of a digitized C2IS makes this possible. As any tactical manoeuvre commander can attest, this is a huge leap in command and control capability, for it goes a long way toward better answering the three questions that have always confounded them: Where am I? Where are my buddies? Where is the enemy? When the COP is shared throughout a command, all levels will experience a heretofore- unprecedented ability to achieve a higher level of shared situational awareness and shared situational understanding.

However, the COP will be worthless without the steady infusion of timely, relevant, accurate and analysed information on the enemy disposition and intent. This fact, therefore, speaks to the inextricable link between Land Force Command and Control Information System (LFC2IS) and the developing intelligence/ISTAR doctrine, capabilities, processes, procedures and, most importantly, products. In other words, there is a direct causal or symbiotic relationship between the two spheres of capability. To develop digitized C2IS in isolation of parallel developments in intelligence/ISTAR, and vice versa, will be to render both as ineffectual.

The key to the success of digitization will not, paradoxically, be the technology.

Finally, the unprecedented volume of data and information which a digitized battle group and brigade group headquarters will have to manage, coupled with the expanded battlespace and the expanded scope of missions and tasks for which units and formations are envisioned to be responsible in the future security environment, indicate the central importance of information management within the domain of the deployed battle group and brigade group. In short, status quo information management structures, processes and procedures are designed for the analogue environment. Therefore, they will need to evolve. The sheer volume of data and information holdings within the headquarters and formation points to the establishment of a cross-functional information management capabilities that are responsible for the overall management of and authority for formation data and information holdings, archiving, and the establishment and maintenance of information management procedures.

In conclusion, for the Army to fully realize the force enabling potential that digitization offers is to ask if it wants to be like those forces that fought at The Somme or Amiens. More to the point, the key to the success of digitization will not, paradoxically, be the technology. It will be our willingness to evolve our doctrine in order to employ the technology to maximum effect. This is as much a cultural question as it is a doctrinal question, for it will force us to take a fundamental re-examination of our beliefs and well-ingrained convictions in terms of the essence of command and control; command decision-making; staff to commander and staff to signals relationships; the ownership, value and management of information and knowledge; simultaneous and collaborative planning processes; and, ultimately, our very understanding of the conduct of land battle. The alternative is to do nothing. But to do nothing will be to turn digitization into an overwhelming and debilitating millstone around the neck of the Army of Tomorrow.

ENDNOTES

1. B.H. Liddell-Hart, *History of the First World War* (London: Papermac, 1992), p. 35.

2. Richard Preston, Alex Roland, and Sydney Wise, *Men in Arms* (Toronto: Harcourt, Brace, Jovanovich College Publishers, 1991), pp. 228-9. See also Geoffrey Wawro, *Warfare and Society in Europe 1792-1914* (London: Routledge, 2000), p. 155.

3. T.H.E. Travers, "Technology, Tactics, and Morale: Jean de Bloch, the Boer War, and British Military Theory, 1900-1914," *Journal of Modern History*, Vol. 51 (June 1979), p. 270.

4. Travers, p. 276.

5. Ibid., 276.

6. Paddy Griffith, *Battle Tactics of the Western Front: The British Army's Art of Attack, 1916-1918* (New Haven: Yale University Press, 1994), p. 10.

7. Michael Howard, "Men Against Fire: The Doctrine of the Offensive in 1914," in Peter Paret, ed., *Makers of Modern Strategy* (Princeton: Princeton University Press, 1986), p. 526.

8. This is not to say that technological change and uncertainty are the only environmental factors that propel doctrinal, organizational and structural change in armies. Political, social and cultural influences are also drivers of change in armies. However, it is argued that technology, more than any other factor, most directly influences the evolution of tactical and operational capabilities. See the introduction to Harold R. Winton and David R. Metz, *The Challenge of Change: Military Institutions and New Realities, 1918-1945* (Lincoln, Nebraska: University of Nebraska Press, 2000).

9. Directorate of Land Strategic Concepts (DLSC) Report 99-2, *The Future Security Environment*, (DLSC Kingston, 1999), p. 24.

10. Gordon R. Sullivan and James M. Dubik, "Land Warfare in the 21st Century," *Military Review* (September 1993), p. 22.

11. *Advancing With Purpose: The Army Strategy* (Ottawa: Land Force Command, May 2002).

12. Robert L. Bateman III, "Pandora's Box" in Robert L. Bateman III, ed., *Digital War: A View from the Front Lines* (Novato, CA: Presidio Press, 1999), p. 15.

13. Robert Leonhard, "A Culture of Velocity" in Robert L. Bateman III, ed., *Digital War*, p. 137.

14. Ibid., pp. 137-51.

15. Although achieving surprise also relies on other factors like deception, secrecy, changes in tactics, directions of attack, etc., improved speed (a higher operational tempo) has the ability to achieve two types of surprise: *Moral Surprise*, meaning the enemy does not know you are coming, and, *Material Surprise*, meaning that the enemy knows you are coming but cannot react in time to do anything about it. Because of the shock and fear induced by hitting an unaware enemy is much higher, the chances of decision are much greater with moral surprise. It should also be pointed out that moral surprise is heavily dependent on tempo—the more time it takes to plan and execute, the less chance of achieving moral surprise. Richard Simpkin describes these two types of surprise in his book, *Race to the Swift*, and attributes them to J.F.C. Fuller. See Richard E. Simpkin, *Race to the Swift* (London: Brassey's, 1985), pp. 182-90.

16. Over the past two years, the author has observed a number of key training, force development and experimentation activities held by some of Canada's key military allies (US, Australia and UK) as well as NATO's AMF(L) HQ. In addition, he served as the senior observer for the Army's "Army Experiment 6" series of experiments in which the early versions of the Land Force Command and Control Information System (LFC2IS) were employed by successively, a battle group and then brigade group headquarters in order provide insight into the respective headquarters' decision-action cycle, and information and system management procedures. The primary objective of each experiment was to assess the impact that "digitization" will have on the planning and execution of warfighting operations at the battle group and brigade group levels during the execution phase.

17. B-GL-300-003/FP-000 *Command*, sect 201. It is also discussed in Annex B to Chapter 6 through the recognition that the most timely and effective combat estimate is intuitive (naturalistic). Yet, the further discussions of the naturalistic approach in the same paragraph leave the impression that naturalistic decision-making is a skill that can only be derived by the most experienced of commanders. Anything less is seen as "extremely dangerous and will lead to disaster."

18. Carl H. Builder, Steven C. Bankes and Richard Nordin, *Command Concepts; A Theory derived from the Practice of Command and Control* (Santa Monica: RAND, 1999).

Lieutenant-Colonel R.L. Bowes, CD

Project Minerva
Command and Control in the Army of Tomorrow

by Major P.A. Duff, CD

It's 2010. The Canadian Main Contingency Force (MCF) Brigade is deployed to combat terrorist elements operating from the southern regions of Farbakhistan. The 1st Battalion The Royal Canadian Regiment (1 RCR) is providing security for the brigade forward operating base. The 1st Battalion Princess Patricia's Canadian Light Infantry (1 PPCLI) is conducting a cordon and search operation against the operating base of a terrorist network. The 1er bataillon Le Royal 22e Regiment (1 R22eR) is patrolling in the local area to assess the humanitarian situation and gathering information on the status of the neighbouring combined arms brigade of the local armed forces, who may not be as trustworthy as they profess.

Meanwhile at brigade headquarters, the G3 Plans is developing three courses of action (COAs) as part of the operation planning process (OPP). She is preparing for the information brief to the G3 and assembling the team and tools she needs to conduct the COA war game.

Project Minerva was established to re-examine tactical command and control in light of the implementation of digitized command and control systems.

Is the planning process described in the second paragraph appropriate to the complexity of operations described in the first? The only sure answer is "we don't know." Project Minerva was established under the sponsorship of the Director of Army Doctrine, to re-examine tactical command and control in light of the implementation of digitized command and control systems. The context for that re-examination must take account of the increasing complexity of warfare, the increasingly prominent role of asymmetric forces, and the expansion of the battlespace that is expected in the future.

The project will have a three-phased approach. First, we will conduct an historical, procedural, and organizational study to examine how we currently plan and execute operations. We will discuss these issues with allies in the American, British, Canadian, and Australian (ABCA) Armies programme. The culmination of this phase will be to propose alternatives to the status quo.

The next phase will include engaging scientists from the Defence Research and Development Canada (DRDC) to subject the current and proposed planning processes to the rigours of scientific evaluation. This research will be based on psychological, sociological, organizational, and human factors.

It is anticipated that the first two phases will recommend some changes to our current procedures. Based upon the outcomes of the first two phases, changes will be proposed and then integrated into the staff structures, procedures, and facilities currently being employed to effect command and control. The implementation of those changes may result in the restructuring of headquarters staffs or the redesign of command post vehicles, infrastructure or systems.

PLANNING AND DECISION MAKING

The OPP taught at the Canadian Land Force Command and Staff College (CLFCSC) and the Canadian Forces College (CFC) are essentially identical. While there are minor differences in the detail due to the operational level focus at CFC, the directing staffs at the two colleges have coordinated their curricula over the years to ensure that students at CFC would not have to "unlearn" what they had been taught at CLFCSC. This consistent approach did not happen instantaneously. OPP was first introduced at CFC and then adapted for CLFCSC. Thus, in the field force we are likely to have a range of experience from the commander who graduated from CFC several years ago to the captain fresh out of CLFCSC. As a result, Project Minerva includes a period of taking stock of how the OPP is taught and practiced throughout the Army.

It has been argued that the OPP is based upon the flawed logic of inductivism and that an alternative model based upon the critical rationalist logic of scientific discovery would better serve the Army.[1] It is proposed to have DRDC conduct an experiment based upon an alternative to the OPP to determine if this change would improve our planning ability.

Among those who study military command and control, a debate currently rages focussed on the competing concepts of naturalistic decision making and analytical decision making. Naturalistic decision making, which is alternately called intuitive or recognition-primed decision making, argues that decision makers are more likely to size up a problem based upon their experience, training, and the facts initially apparent rather than a deliberate, analytical process. This critique has some aspects consistent with the critical rationalist critique above. The research in naturalistic decision making has been conducted primarily in the United States. Since decision making is heavily dependent on cultural factors, it would be foolish to import these techniques without examining them in light of the Canadian Army culture. Project Minerva will provide the vehicle to test these competing concepts in the Canadian context.

STAFF STRUCTURES

Our staff system is still based on a British staff model. Despite adopting the continental staff designators in the 1980s, the G3 and the G4 play much the same role as the Brigade Major and the "Q" and "A" staff officers did in the Canadian Army of the 1960s. To understand where we are now, we must understand whence we came. The project will describe the historical development of the Canadian staff system.

Staff structures are partly products of culture, and we can see a number of alternatives. We can revert back to the classical British system, we can fully implement the continental system, or we can adopt some radically different approach. The staffs are currently structured along functional lines (G1 to G9). Other factors that affect how we structure our staffs are the nature of the task (i.e., mission planning and the supervision execution), the way humans work together in teams that are structured by rank and expertise (trades, classifications, and specialties), and the tools available to assist the team in the accomplishment of the tasks. All of these factors will be examined as part of the project.

Staff structures are partly products of culture...

LONG TERM WORK

The final phase of the project will draw upon the conclusions of the earlier work to examine whether we can make the equipment fit the human. The three field force brigade headquarters are currently organized in three different ways. The reason for this is likely due to differences in equipment allocation, staff organization, and in the way the staff operates. Implementation of digitized command and control will constrain the freedom of the brigade headquarters to reorganize because of the physical architecture needed to establish the computer networks. As a result, we should ensure that the headquarters layout serves the headquarters and not vice versa. Accordingly, Project Minerva will include an examination of a range questions from vehicle and computer design to the arrangement of the staff section within a command post. It is important for persons to be located in positions that are logical to the workflow and not simply to the geometry of a vehicle arrangement or the wires that connect the computers.

The ultimate goal of Project Minerva is to develop processes and equipment that most appropriately support the essential human aspects of the command of military forces. In the past we have allowed the changes to take effect through a series of incremental decisions made in disparate parts of the Army. The object of this effort is to engage all aspects of the Army and the research community to recommend only those changes that are useful, relevant, and enduring.

ENDNOTE

1. See Lieutenant-Colonel R.E. Giffin, "Superstitious Rituals Naive Inductivism in Command and Control Doctrine: Its Causes, Consequences and Cures," presented to the 7th ICCRTS, Québec City, September 2002, available on the DIN at http://img.mil.ca/dgimsd/dimsp/dimsp5/documents/documents_e.htm

Major P.A. Duff, CD

The Land Force Command and Control Information System Version 1

Training Strategy

by Lieutenant-Colonel J.P. Bergeron, CD and Major L. Xenos, CD

The Land Force Command and Control Information System Version 1 (LFC2IS v1) is intended to provide commanders and staff with a coherent package of automated command and control tools. The Army's desired end state is to have all formations and units employing integrated LFC2ISv1 tools, appropriate to their level of command, in an operationally effective manner. Accordingly, the Land Force Doctrine and Training System (LFDTS) has been assigned responsibility for all matters concerning the design and execution of the LFC2ISv1 training. The introduction of this new and complex command and control (C2) system necessarily demands an equally new and unique strategy for conversion and steady-state individual and collective training. Therefore, the aim of this article is to outline the Army's plan for the design and execution of the LFC2ISv1 training strategy.

CONVERSION TRAINING

The aim of LF C2IS V1 Conversion Training is to familiarize commanders and staffs, primarily at the brigade group and battle group levels, with the decision action cycle tools inherent in LFC2ISv1 in order to provide them with the capability to "digitally" command and control military forces. Its focus is on operators and does not include the training of system management personnel. This training will not achieve interim operational capability (IOC) until the field force is able to command and control forces, employing LFC2IS, in an operational field training environment. Because of the relatively unprecedented level of capability resident in the system, and because there were no ready-made user procedures, the commander of LFDTS created the Army Digitization Office in Kingston (ADOK) in the spring of 2000 to develop the missing procedures and related training packages, and subsequently execute the conversion training. Since 2001, based on applications' prototypes and after two Army Experiments, 6A and B, ADOK has produced a draft user procedures manual[1] for the use of LFC2ISv1 at the brigade and unit levels. The conversion training guiding principles are as follows:

- Just in time training to maximize currency and retention.
- Train to need; only train personnel on systems they will operate.
- Train on own equipment at home location.
- Provision of in-location training capability to the chain of command.
- The Army training and operations framework (ATOF) provides the determinant structure for scheduling of conversion training.
- Flexibility to accommodate fluctuating dates for fielding due to delivery delays and unexpected operational commitments.

Accordingly, the conversion training concept will be characterized by a decentralized approach that will see area commanders, regular force brigade commanders, and the commander of the Combat Training Centre (CTC) provided with the necessary training resources such as area training cadres, synthetic training facilities (digitized simulation centres and LFC2IS training classrooms), computer-based training (CBT) packages, and the soon to be activated LFC2ISv1 help desk, in order to develop a digitized command and control (C2) capability within their respective spheres of responsibility. The standard LFC2ISv1 conversion training package for an individual will be based on a two-week program: one week of individual training using CBT, and a second week in which the individual attends collective training as part of their parent organization. Therefore, due to training facility and resource limitations, it might mean that the training period for a brigade headquarters and brigade units (engineers, artillery, etc.) is four weeks (three weeks of individual training and one week of collective training), while the training period for a manoeuvre unit or sub-unit is two weeks (one week of individual training and one week of collective training). Training period determination will be based on the availability of functional LFC2IS V1 software packages in time to develop the individual training packages to support all of the LFC2ISv1 functionalities and components in both English and French, and the exercise instructions required to support the ADOK directed collective training. In advance of conversion training activities, time will be required to establish and confirm the technical set-up of classrooms and Janus Sites. Finally, LFC2ISv1 system functionality must be confirmed (in advance of the training) on the equipment being used for the training.

It must be emphasized here that the ADOK conversion training package only allows for the introduction of LFC2ISv1 to the field force. Achieving an operationally

effective and comfortable ability to employ the system will only come once field force units and formations have had the time and opportunity to use the new C2 capabilities extensively in the field on training and operations.

STEADY STATE INDIVIDUAL TRAINING

The Director of Army Training (DAT) will develop and execute an individual training plan for its users/operators, administrators and maintainers who will be working within a digitized C2IS environment, as well as a collective training plan for units and formations. However, "steady-state" training will not take effect until the next round of qualification standard (QS) revisions and the successful completion of the command support pilot project in fiscal year 2004/2005. Transition to steady state will occur once a training requirement has been fully defined, considered by QS boards, and subsequently captured in Army courses—the requirement defined as a series of performance objectives and enabling objectives. Before integration into steady state is possible, final structures and doctrine must be also known. Therefore, since there are significant outstanding structure questions, and since LFC2IS components may well affect doctrine profoundly once fielded, steady state capture for LFC2IS is not possible at present. For the near future, LFC2IS will be considered in this cycle as a particular "interim steady state" requirement. Therefore, individual training will take the form of stand-alone packages and /or modules annexed to existing courses identified within the Army Development Period (DP) Model. These modules will be based upon ADOK's conversion training packages (individual and collective). As well, specialist training such as system administration will be implemented as Occupation Specialty Specifications (OSS).

The interim steady-state training strategy includes individual training for both signals and non-signals personnel. Presently, the staff of DAT, the Canadian Forces School Communications and Electronics (CFSCE) and the CTC are developing and implementing within the Army DP Model the following LF C2IS V1.0 training:

SYSTEM ADMINISTRATION FUNCTIONS

- C2IS Network Administrator. The C2IS Administrator tasks are those associated with the administration of the computer software running on the Athene Tactical System (ATS) based on the Windows 2000 Operating System. The individuals filling this role must attend a Basic Data Communications Course and a Windows 2000 Operating System Administrator Course. This training will be delivered as an OSS.

- Athene Tactical System Database Administrator. The ATS database administrator tasks are those associated with the overseeing of data integrity residing on the SQL 2000 server. This training will be delivered as an OSS.

- Athene Tactical System Maintainer. The ATS Maintainer tasks are those associated with ATS hardware repairs, modifications, upgrades, and repairing the ATW System hardware over the Iris network. This training will be delivered as an OSS.

- Iris Network Administration. CFSCE and DAT have recommended that the following Iris administration functions will be delivered as an OSS:

  - Facility Controller (FC). A Signals Operator at the brigade and battle group (BG) headquarters, responsible to manage and control the Iris system within the brigade and the BG. The FC will have taken training on crypto management and UNIX.

  - Crypto Material Management System (CMMS) Specialist. This Signals Operator is responsible for the management, control and distribution of cryptographic material. This includes equipment, software, applications, data, and implementing communication security procedures and regulations. In other words, CMMS generates, manages and distributes key material and hop sets used by custodians and custodian clerks.

  - Radio Relay Vehicle Operator. A Signals Operator who is responsible to deploy, configure, and operate the radio relay system. In particular, he/she would be responsible to set-up the communication system AN/URC-512, and configure, program, and operate the radio set AN/GRC-515 (V). This specialist could be found at the unit and brigade level, responsible for sustaining the communication backbone.

  - Communication Management System (CMS) Specialist. This Signals Operator is able to conduct communications planning, generate plans for each FC, generate a network security plan for CMMS, maintain status of all communications equipment, and generate orders.

  - Tech Controller. This Signals Operator oversees the management, inter-workings and component linkage of the Iris network.

  - Iris Administrator. This Signals Operator is responsible to configure and monitor the communication network and the administration of the software running on those

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devices over the Iris system. This includes the network operating systems (SCO UNIX, Oracle DB, Genamap and Iris software installation).

LFC2IS/IRIS USER FUNCTIONS

At different periods within the Army DP Model, officers and non-commissioned members (NCMs) from other arms/branches will receive training on the various components of LFC2IS and on the Iris backbone:

- Common Army Phase (CAP). During DP 1, all army officers will receive training on the Iris manpack and on the Precision Lightweight Global Receiver (PLGR).
- Soldier Qualification (SQ). During DP 1, all army NCMs will receive training on the Iris manpack and on the PLGR.
- MOC Training. During DP 1and/or DP 2 MOC training, officers will receive Combat Net Radio (Primary) (CNR(P)), Iris data terminal, Tactical Message Handling System (TMHS), and Situation Awareness Module (SAM) training. Some specialists such as engineers, armour reconnaissance and artillery officers will also receive ATS training during their DP 2 MOC training.
- Army Operations Course (AOC). During DP2, all army officers will receive ATS and Operational Planning Environment and Reference Application (OPERA) training on the AOC starting in the fall of 2003. This training will include computer-based training (CBT) and practical use of ATS during computer assisted exercises.
- Army Tactical Communication Information System (ATCIS) Operator Basic. During DP 2, a select number of other arm/branch NCMs, dependent on their employment in unit and brigade headquarters, will receive advanced Iris training. The individual will receive in-depth knowledge in system networking to include operating the CNR(P), TMHS, Iris data terminals, crypto, high frequency (HF) radio, antenna theory, and system security.
- LFC2IS Operator Basic. Signals Operators and a select number of other arm/branch NCMs will require ATS, Situation Awareness System (SAS) and OPERA training, again dependent on their employment within unit and brigade headquarters. The combat arms NCM attending this course must have completed the ATCIS Operator Basic course.
- Army Tactical Information Management (ATIM). During DP 3, a select number of other arm/branch NCMs will require advance LF C2IS training in information management (IM). The individual will receive general knowledge in system networking and in system applications. Tasks include preparing the SAM and the ATS workstations for a mission, distributing geo products and start states, ensuring integrity of data, and will be granted ATS privileges to perform delegated routine IM tasks. This course will also introduce the attendee to the operational planning process (OPP) and military staff duties.

COLLECTIVE TRAINING

The Army's intent for digitized support to collective training will be to establish collective and continuation training simulation facilities and suites (a synthetic environment) at formation and school sites (Petawawa, Kingston, Valcartier, Edmonton, Gagetown, and Wainwright). These digitized training facilities will be permanently established and provide locally available collective training support for army units, schools and formations using the tools and components inherent in LFC2IS. Each facility will be operated by a small permanent training support cadre responsible for the administration and management of all equipment, software systems, communication networks, databases and data used within the facility. Each digitized training facility will have a set of networked computer workstations which, when configured as an emulation of the appropriate field headquarters facilities, will enable the conduct of command post exercises (CPX) to practice complete headquarters functionality in the exercise of command and control at combat team, battle group or brigade group levels within an operational scenario. The facilities will provide an artificial training environment adequate to enable the individual and collective training of Army commanders and staff on the use of Iris TMHS, Iris SAM, ATS and the OPERA without employing operational vehicles or equipment. This includes the use of appropriate constructive battlefield simulation(s) to stimulate the users in directing and monitoring the execution of tactical operations using SAS, ATS and OPERA.

ENDNOTE

1. Published by the Army Digitaization Office in Kingston (ADOK), the actual manual is entitled *LFC2IS Decision-Action Cycle Procedures Manual*. These user procedures are colloquially known as the LFC2IS tactics, techniques and procedures (TTPs)

Integrating "Digitization" into the Canadian Land Force Command and Staff College:

A Concept of Operations for Digitization

by Colonel J.R. Ferron, CD

The Army Commander intends to exploit digital information (hereafter referred to as "digitization") to enhance command and control and facilitate force multiplication. In this context, digitization will provide the means to rapidly execute the decision-action cycle, thereby dominating the information environment and enhancing combat power. To accomplish this, the Commander will establish situational awareness and a common operating picture at all levels. The main effort will be the provision of a common set of communications/C2IS tools and data, with supporting processes and structures, which will allow for the management and rapid transmission of information throughout all levels of command. The end state will be achieved when the Army is able to operate effectively with digitized command and control, at the formation level and below, within both joint and combined operations.[1]

Taking its cue from the Army Commander's concept of operations for digitized command and control, the Canadian Land Force Command and Staff College (CLFCSC) will integrate the major components of the Land Force Command and Control Information System (LFC2IS) into its new course titled the Army Operations Course or AOC.[2] The aim of this article is to provide an insight into how the Staff College will integrate digitized command and control into the AOC as early as the summer of 2003; which will no doubt be of particular interest to potential course candidates.

In a recent edition of *The Army Doctrine and Training Bulletin*, the Staff College outlined the various phases of the AOC and gave an initial impression of how we would facilitate command and control through digital means. Essentially, "digitization training" will be isolated to the Distributed Learning and the Residential phases of the course. The focus of this effort will rest with the employment of the Athene Tactical System and the Operational Planning Environment and Reference Application (OPERA) programme. Developing situational awareness will also be a key feature of the College's approach to digitization. It is important to emphasize that the intent will not be to subordinate the human aspects of command; in fact, the opposite will be the norm. The College's approach to digitization will continue to stress that command is a human factor with leadership being its most important component. Moreover, it will also strive to develop an understanding of the potential that digitized command and control will offer commanders in the field in terms of developing and maintaining an improved level of situational awareness. These components of LFC2IS, with their resulting capabilities, will be synchronized with the various simulation tools employed by the Army Simulation Centre to provide the College with a "synthetic environment" that will create the conditions for digitized command and control.

The College's digitization focus will differ between the Distributed Learning and the Residential phases of the AOC. During the latter portion of the Distributed Learning Phase, students will receive an Athene Tactical System computer-based training programme and an instructional package for OPERA. Both of these training tools are designed to develop in students an understanding of the individual skills necessary to operate Athene and OPERA (in the past some have referred to this training as "buttonology"; however, such a term does not fully express the extent of knowledge that students will obtain during the Distributed Learning Phase of LFC2IS training). Upon arrival at the College for the Residential Phase, the emphasis will switch to an employment of LFC2IS in order to facilitate an understanding of the collective skills associated with battle procedure and the operational planning process. This will involve the employment of Athene and OPERA to assist with collaborative staff planning and the execution or command and control of current operations.

Developing situational awareness will also be a key feature of the College's approach to digitization.

In particular, the Residential Phase will be sub-divided into two tutorials. In Tutorial One, the emphasis will be on the planning and execution of operations at the battle group level. Shortly after arrival, armed with the technical knowledge and skills acquired during the Distributed Learning Phase, students will undergo an

Colonel J.R. Ferron, CD

intensive 2[1/2] day LFC2IS training package, the main effort of which will be to develop an understanding of how LFC2IS can be employed at the battle group level to facilitate the decision-making process. In this regard, the "LFC2IS Decision-Action Cycle Procedures Manual," developed by the Army Digitization Office in Kingston (ADOK), will be extensively employed—this manual provides the tactics, techniques and procedures of digital C2. On completion of this package, students will utilize LFC2IS throughout the remainder of Tutorial One, whether it is to prepare for syndicate discussions, to complete assignments, or to conduct exercise planning, command, and control on any of the battle group exercises contained within the first tutorial.

In Tutorial Two, the aim will be to develop an ability to conduct operations at the brigade group level with the final exercise culminating at the division level within a coalition context (the new name for the final exercise will be Exercise FINITE ENDEAVOUR, with the last Exercise FINAL DRIVE scheduled to take place in June 2003). As with the first tutorial, this tutorial will commence with a concentrated period of LFC2IS instruction focussing on both the information management and decision-action cycle procedures necessary to plan, command, and control formation level operations. Subsequently, LFC2IS will be employed on the two brigade group exercises, plus Exercise FINITE ENDEAVOUR, all of which are integral to the second tutorial.

To facilitate the integration of LFC2IS into the Staff College, a significant degree of information management/information technology support will be required. Organizations such as Directorate of Land Command and Information (DLCI), Directorate of Land Requirements (DLR), Directorate of Land Command Systems Programme Management (DLCSPM), 2 Area Support Group/Area Support Unit Signals Squadron plus various Land Force Doctrine and Training System (LFDTS) organizations such as the Directorate of Information (DInfo), the Army Simulation Centre (ASC), ADOK, and the Directorate of Army Doctrine (DAD) are all examining their ability to support the College's LFC2IS integration concept. Furthermore, the College is presently being provided with a substantial increase to its current Athene/OPERA hardware and software holdings. For example, on arrival all students will be issued with an LFC2IS compliant laptop, with docking stations available in student rooms, syndicate rooms, and the brigade training rooms that are contained within the exercise facility in Normandy Hall. This concept will be expanded to include ASC's new training facility to be constructed in the former CFB Kingston Anderson Gym complex (completion date is expected in the year 2004). Furthermore, to facilitate the development and maintenance of staff situational awareness, large screen display technologies will be integrated into all facilities supporting the College's agenda. When all of the above are combined with LFC2IS instructor support from the College, ADOK, and potentially ASC, the College will have a complex synthetic environment developed, designed, and resourced to support its LFC2IS integration plan.

As a final point it should be understood that the College will not train all personnel in the employment of digital tools to enhance the decision-making process. Initially, students arriving on courses such as the Commanding Officer's Course (COC) and the Militia Command and Staff Course (MCSC) will only be exposed to the concept of digital command and control. It will be the responsibility of the field force to conduct the necessary training to convert these personnel to the LFC2IS tools available within their units and formation headquarters. However, in the future it is conceivable that all courses taught at the CLFCSC will employ digitization to enhance the ability of both commanders and staff in the art of decision making.

In conclusion, the way ahead contains many challenges, most of which remain unidentified to date. However, the option of waiting for the perfect solution is untenable to the College and the Army as a whole. The necessary risks must be taken to introduce digitization into the College as soon as possible to prepare future leadership with the tools required to fight on the battlefield of tomorrow. The voyage has only begun–resistance is futile–you will be digitized.

The College's digitization focus will differ between the Distributed Learning and the Residential phases of the AOC.

ENDNOTES

1. 3000-1 (Dir ADOK), ADOK's Report on Record of Decisions—LFC2ISv1 Implementation Working Group—13/14 Dec 00, dated 8 Jan 01.

2. For a detailed description of the AOC, and an initial impression of how the Staff College will facilitate command and control through digital means, see *The Army Doctrine and Training Bulletin*, Vol. 5, No. 3 (Fall 2002).

Digital Interoperability

by Lieutenant-Colonel P.C. Cooper, CD, Major K. McKay, CD, and Major S.J. Murray, CD

Digitization has not been a solely Canadian military initiative. Nearly all western nations have been in the process of digitizing their armies for well over 20 years. The original Canadian army digitization requirement was written in 1965 under the auspices of Commander Canadian Forces Europe. As most national military strategies are premised on coalition operations, it has become apparent that as each nation implements its digitization program, there exists a requirement to ensure a certain level of interoperability among national programs. The aim of this article is to examine two of the more salient efforts to ensure command and control interoperability between armies. Part I describes the Multilateral Interoperability Program (MIP) and the dedicated efforts to reach interoperability of operational data exchange between armies. Part II describes the American, British, Canadian and Australian (ABCA) standardization program exercise, Coalition Interoperability Demonstration Borealis 2002 (CID BOREALIS 2002), which is the culmination of a three-year effort to determine the baseline of communications and tactical network interoperability. Although these two programs are not formally linked, ABCA is becoming more cognizant of the MIP program with a view to standardizing on the successful implementation of a MIP data exchange solution. While both efforts are unique in their focus, the totality of their combined efforts will result in an ability to deploy with our allies in a digital coalition.

Lieutenant-Colonel P.C. Cooper, CD, Major K. McKay, CD, and Major S.J. Murray, CD

MULTILATERAL INTEROPERABILITY PROGRAM

As the development and fielding of national command and control information systems (C2IS) gathers momentum in the armies of our key allies, the unique doctrinal and technical challenges to coalition C2IS interoperability have yet to be fully resolved. Since 1999, one of the most active organizations wrestling with these issues has been the MIP.

The stated aim of this program is to:

> *...achieve international interoperability through the automated exchange of information between Land Component Command and Control Information Systems (C2IS) of participating nations at all levels from corps to battle group, or the lowest appropriate level, in order to support multinational, combined and joint operations and the advancement of digitization in the international arena.*

As shown in Figure 1, all North Atlantic Treaty Organisation (NATO) members except Luxembourg and Iceland are active program participants of MIP. Associate membership extends outside the NATO sphere to include Australia and Austria. In addition, countries from as far away as South Africa continue to monitor program activities. Individual representatives to the program are drawn from a variety of national sources including military information systems project management offices, doctrine directorates, communications establishments and supporting civilian agencies.

MIP has identified two relatively simple program objectives. These are to:

> *develop a capability to exchange fixed formatted messages at formation and battle group level between land component C2IS of participating nations both horizontally and vertically and to develop a capability to push selected data at formation and battle group level between the land component C2IS of participating nations.*

The original Canadian Army digitization requirement was written in 1965.

The successful implementation of these objectives will have a major impact on future command and staff processes by reducing human involvement in the routine exchange of essential operational information.

The physical outputs of the program will include a technical specification to be used by national C2IS system developers to ensure a minimum level of C2IS interoperability and essential doctrinal guidance to ensure a common employment concept of the technical solution during coalition operations.

Concept of Operations. The key operational needs identified by MIP for digital coalition operations include: the ability to describe the current friendly force situation, the current enemy force situation, the projected enemy force situation, the historical enemy situation (intelligence summaries) and operational plans and orders. In addition, the program has identified the requirement to exchange a small number of "writer to reader" messages such as nuclear, biological and chemical (NBC) warnings and reports.

The program has deliberately excluded information exchange designed to support real time execution processes. For example, the artillery "Calls for Fire" has not been included.

The information exchange concept developed by MIP is relatively simple. The solution co-locates the C2IS of participating nations in a single location and establishes a local area network (LAN). Pre-specified information (unit locations, facilities, control measures etc.) is passed from national databases through national communications links to the LAN. As shown in Figure 2, this information may be exchanged using formatted messages or through automated data replication between databases. Once in the central database it can be extracted by the other participants and sent back to their own headquarters (HQ) over their own communications links. By defining what information will be exchanged as well as how it is organised within the central database, participants eliminate the requirement for direct C2IS technical interoperability.

Within the concept, there are three major operational issues to be resolved:

- "What information must be exchanged between participants in order to meet the operational needs?"
- "How do we describe these information elements so that there is a common understanding of their meaning?"
- "How do we organise the information so that the individual information elements can be related to one another?"

Information Exchange. Within MIP, an operations working group (OWG) is established to identify and describe the information requirements needed to meet the basic operational needs. The group has reviewed a wide variety of NATO and national doctrine manuals, standard operating procedures (SOPs) and STANAGs. In addition, related work from preceding programs such as the Quadrilateral Interoperability Program (QIP) has been leveraged. The analysis and subsequent agreements on the information requirements have been consolidated in a document known as the MIP Tactical Interoperability Requirement (MTIR). For each operational need, the document identifies the minimum information that must be passed between nations. As an example: a basic description of the "current friendly situation" includes a description of friendly military units (names, disposition, activity, material holdings, operational status, etc.) together with relevant terrain information (obstacles, facilities, etc.) and current control measures (boundaries, checkpoints, etc). The MTIR is subject to continuous update and revision as doctrine evolves and operational lessons are learned.

Describing the Information. Imagine it is now 2006. You find yourself as the G3 operations (Ops) in a digitized Canadian brigade group headquarters. The brigade is currently OPCON to a multinational French division. The Utopian brigade to your left has not yet been able to establish C2IS connectivity with your HQ and has decided to send structured, hard copy situation reports (SITREPs) until the problem is sorted out. Your intent is to manually transfer the Utopian SITREP information into your C2IS as the reports arrive. You scan the first page of the 20 page SITREP (Table 1) and begin to sweat.

Despite the fact that all of the requested information has been provided, it contributes nothing to the situational awareness of your headquarters. You spend the next hour with the Utopian brigade liaison officer translating the report and another 30 minutes inputting the report. Just as you finish typing, the second Utopian SITREP arrives.

This simple example shows the importance of standardizing definitions and meanings for each of the information requirements. Within MIP, this standardization is accomplished through the use of common NATO doctrine (where it exists). NATO has defined a wide variety of information requirements that are represented within a standard data model (the NATO land command and control information exchange data model (LC2IEDM)) and associated data specifications (NATO Allied Data Publication 3 (ADatP-3)). In the example described above, it was possible to develop an understanding of the information through personal communication with the liaison officer or the reporting HQ. The associated cost is a reduction in the timeliness and quality of the information. The use of personal communication to "decipher" allied information may not be possible when using formatted messages or automated data exchange. For example, if your C2IS is seeking location information in a six-figure military grid reference format, it might interpret the Utopian 1st Battalion Prince Peter's Consolidated Light Independant location as GR 332215. Unless the unit icon appeared outside of the area of operations, the recipient might never notice the error.

Organizing the Information. A data model is simply a specification describing how data is organised and the rules needed to represent the environment the data describes. The MIP has adopted essential elements of the NATO LC2IEDM to describe the structure of the supporting information. By organising operational information in a common model, C2IS developers are able to map national data structures to a common agreed format. This reverse engineering approach has the clear advantage of minimising constraints on national C2IS development

There are three major operational issues to be resolved.

Figure 1: Member Nations

The LC2IEDM is aimed at describing and relating the critical "objects" on the battlefield as shown in Figure 3. The key "objects" include organisations (military units, civilian organisations, etc.), persons, material (ammunition, fuel, etc.), features (terrain, graphic control measures, etc.) and facilities (command posts, bridges, minefields, etc.). Each object can in turn be associated with locations, actions and/or capabilities. This construct allows a C2IS to "link" operational information to these objects in a highly structured format. By pre-specifying the objects and information needed to describe a particular situation, we can automate the generation, dissemination and processing of virtually all of our current reports and returns.

While the data model employed by MIP will support the exchange of situational awareness information between allies, it is not intended to support internal national processes. These national processes include activities such as ORBAT management, material management, human resources, training, operational planning and extended intelligence/ electronic warfare. As a result, the Canadian land force data model (LFDM) will need to expand on the current MIP model to facilitate these processes.

Doctrinal Issues. While the primary "deliverable" of the MIP is a technical specification to enable C2IS interoperability, the technical solution will raise a number a number of doctrinal issues that will need to be resolved. Issues include communication information system (CIS) planning and responsibilities within the coalition, reporting frequencies to achieve near real time situational awareness, processes to manage the data model and specifications during operations and information security.

The MIP agreements regarding information exchange also imply an underlying responsibility for each participant to actively collect and store the exchanged information. In effect, each nation will need to implement information management SOPs to ensure that essential agreed information is "pushed" up the chain of command.

Future Activity. The next major milestone for MIP is the conduct of an interim operational test and exercise scheduled for the autumn of 2003. Test objectives include: confirming the operational fieldability of the formatted message exchange solution, testing and evaluating the operational fieldability of the automated data exchange solution, and testing and evaluating the ability of the message exchange and data exchange solutions to coexist. The exercise will involve the deployment of a skeleton HQ from each participating nation together with their supporting C2IS. The lessons drawn from this testing program will enable further development of the technical solution, data model and doctrinal requirements. A full operational test and exercise will be conducted in 2005.

Relationship with NATO. As noted earlier, MIP is not an official NATO program. Despite this disconnect, NATO has a stake in the results of the development work. NATO has published a recent policy statement that states in part:

- NATO will therefore provide visibility of its plans, programs, activities and products to the MIP and encourages reciprocal visibility.
- NATO wishes to avoid duplicating activities being conducted within MIP if the results of these activities will be of benefit, and will be provided, to NATO.
- In recognition of the limited resources that can be allocated to achieving interoperability, NATO seeks to agree to common C3 interoperability requirements and priorities so that these can be promptly met through collaboration, coordination and shared work programs.

The Multilateral Interoperability Program is a critical component of future Army interoperability with our allies.

Lieutenant-Colonel P.C. Cooper, CD, Major K. McKay, CD, and Major S.J. Murray, CD

- NATO wishes to avoid a situation in which the standards and solutions developed and implemented in NATO diverge from those implemented in the MIP.

Efforts are currently underway to ensure the implementation of this policy. The Multilateral Interoperability Program is a critical component of future army interoperability with our allies. From a Canadian strategic perspective, our participation in the program allows us to leverage international research, development and related expertise in support of our own digitization efforts. From a tactical perspective, the successful implementation and fielding of the solution within the LF will ensure that we remain relevant on the future battlefield.

COMMUNICATIONS AND TACTICAL NETWORK INTEROPERABILITY—EX CID BOREALIS 2002

CID BOREALIS 2002 was conducted at Canadian Forces Base Kingston, Ontario, Canada from 9 - 22 June 2002. CID Borealis 2002 involved armies of five participating nations (United States of America (USA), United Kingdom (UK), Canada, Australia and New Zealand) with over 400 military and civilian personnel conducting testing and host nation support. Approximately 200 visitors toured the site during the demonstration. The aim of CID Borealis 2002 was to test CIS interoperability among the participants in order to prepare and enable those nations to operate together in support of coalition tactical operations. Accordingly, the objectives of CID BOREALIS 2002 were to:

- Identify planning, operational, technical and support procedures to achieve CIS interoperability.
- In terms of a coalition tactical network, to establish and test a coalition voice and data network that would confirm discrete communications and information system interoperability and to establish the capability of data and voice networks via various means (including a variety of transmission systems and network configurations).
- In terms of testing, to confirm communications connectivity and information system interoperability, to test the capability of data and voice networks via various means, and to test the stability of communications connectivity.
- In terms of analysis, to document the level of interoperability achieved to date, to produce a list of achieved and non-achieved interoperability areas to guide future CIS planning, to document areas for required future work, and to validate a list of Quadripartite Standardization Agreements.

From an operational perspective, the two-week demonstration proved valuable in terms of the significant observations gleaned from the testing and analysis phases. In particular it was demonstrated that among the five armies there exists an adequate level of interoperability to exercise authority and direction over assigned or attached forces via radio. This baseline capability demonstrated that the armies would be able to coordinate and synchronize manoeuvre units and staff activities, and assess the current situation at a basic level. Moreover, as each of the armies implements various digitized command and control systems, the quality and quantity of shared yet perishable information will improve thereby improving the ability to exercise command and control. A balance of technological and liaison solutions need to be maintained to ensure that an ABCA tactical command and control system can maintain situational awareness through a redundant means. The dependence on digital devices to provide information will increase which also increases the risk that nations will not have or still use analogue systems to fall back on, in the event of a digital failure, cyber or electronic warfare (EW) attack.

The exercise also demonstrated the need to standardize equipment specifications, as well as procedures and doctrine to address both the process and methods of providing accurate, timely, and relevant information distribution between coalition partners in operational settings. While nations can send formal military messages within their own tactical CIS architecture, incompatibility between national applications hinders timely distribution of information, and

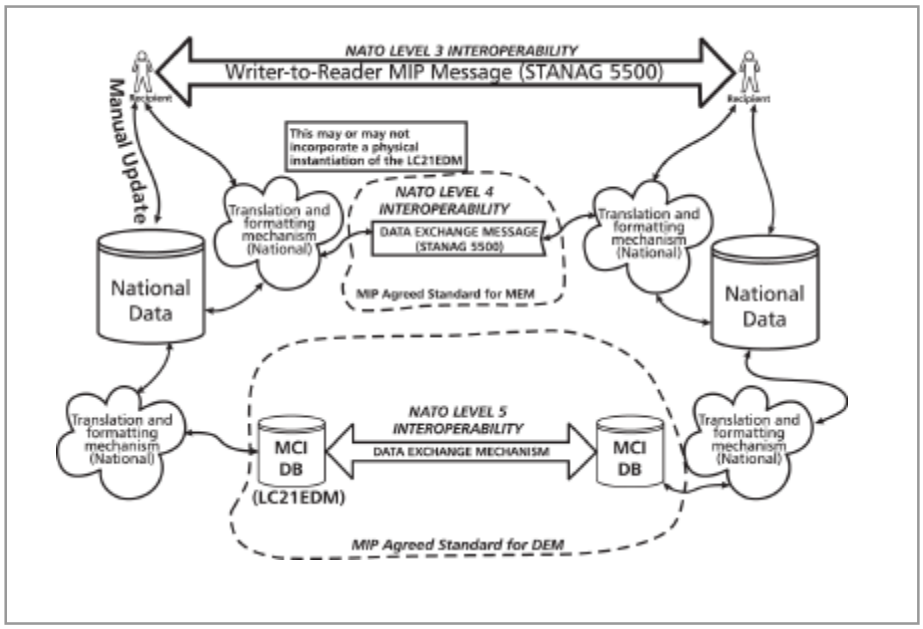

Figure 2: Interconnectivity Levels

decreases their ability to achieve timely situational awareness information. The impact is dependant on the level of command and the operational tempo. Workarounds, software, or emerging technologies are currently improving and will continue to improve interoperability of these systems in the future. However, establishing technical interoperability betweens systems does not guarantee the full use of feature sets, which certain staffs may require to conduct operations. As a result, the flexibility of the commander to execute command and control may be limited, depending on the architecture and the nations involved.

The continued documentation of test circuits used at CID BOREALIS 2002 will enable the five armies to develop and maintain configuration management and engineering standards among them. In addition, the knowledge gained will serve to assist in the planning and conduct of future operations involving ABCA nations.

Emerging technologies are likely to change the nature of coalition operations due to the presence of contractors on the battlefield, greater need for information management, information filters, and real-time lateral collaborative planning. Mapping geographic information and geographic information system data, wireless communications, software gateways to connect C2IS Commercial Off The Software (COTS) with national battle-command systems, and the proliferation of COTS products to the lower echelon units are the emerging technologies most likely to impact future coalition operations. The major implications of the increased reliance on contractors is the physical risk to contractors and associated legal ramifications, and the risk of losing in house military knowledge. The reliance on contractor support may translate into a loss of flexibility or self-sufficiency as military personal lose the ability to address problems and make the necessary repairs in a field environment.

As a result of the above observations, the ABCA program operational evaluation staff has made the following recommendations:

SITREP—1st Utopian Brigade effective 212100Z Jan 06		
	Information Requirement	**Information**
01	Unit Name	1st Prince Peter's Consolidated Light Independent (1 PPCLI)
	Unit Type	Light Surface to Air Missile Reconnaissance.
	Unit Size	Task Force
	Unit Location	33/22/15 North 12/56/10 East
	Affiliation	Own
	Current Activity	DISTURBING enemy first echelon
	Combat Effectiveness	Purple
	CIS Status	Broken
	Fuel Status	50000/12567
02	Unit Name	

Interoperable:	Achieved full functionality with no configuration changes.
Partially Interoperable:	Achieved partial functionality or required a configuration change to achieve at least minimum functionality
Not Interoperable:	As determined by testing
Not Interoperable:	Deemed not interoperable based on technical specifications
Not Tested:	Scheduled but not tested

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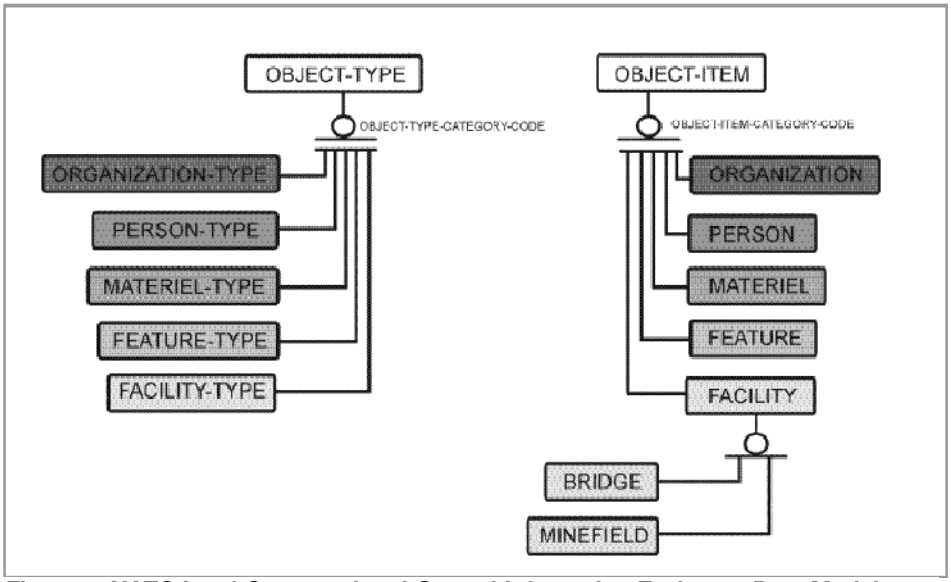


Figure 3: NATO Land Command and Control Information Exchange Data Model (LC21EDM)

- The ABCA program place emphasis on interoperability/ future stadards development.
- The ABCA program place emphasis on future initiatives relating to operational and technical interoperability.
- The ABCA program place emphasis on ensuring a level of "interoperability of the mind" is maintained and developed such that the armies are able to predict how other nations will react to the same piece of information.
- The ABCA program place emphasis on developing common levels of interoperability, in parallel with development of common technical standards.
- The ABCA program place emphasis on accommodating both current and future technologies in standardization initiatives.
- The ABCA program develops a "way ahead" for CIS interoperability in the ABCA programs.

From a technical perspective, the two-week demonstration also proved valuable in terms of significant observations. The aggregate interoperability results can be summarized as combat net radio services—interoperable, network services—not interoperable, and user services—partially interoperable. A more detailed accounting indicates that combat net radio (CNR) was found interoperable for test results associated specifically with VHF, HF and UHF voice. Network services were considered partially interoperable for transmission, not interoperable for multiplexing, digital switch trunking and wide area network connectivity. User services were categorized as interoperable for file transfer, voice switch and commercial based local area network features, partially interoperable for commercial email, and not interoperable for military format messages and database update/exchanges.

As a result of CID BOREALIS 2002, the ABCA Special Working Party-Interoperability Engineering (SWP/IE) will be addressing future work items for the next ABCA Interoperability Demonstration to take place under the auspices of a US Joint Force Command exercise in spring of 2004. Canadian Army participation will be based on 2 Canadian Mechanized Brigade Group Headquarters and Signals Squadron, who will be placed under operational control of the US Land Force component, the 82nd Airborne Division. As the aim of this demonstration is to exhibit land tactical command and control interoperability, SWP/IE will work towards closing the capability gap on some of the more critical and common coalition CIS interoperability problems, specifically with regard to provision of a stable transfer common protocol/internet protocol (TCP/IP) based divisional network, IP addressing, switches and multiplexing. In addition, every ABCA member nation will undertake to focus resources on specific bilateral interoperability problems, to further assist in closing specific CIS interoperability gaps.

For CID BOREALIS, the detailed operational and technical reports examine in much greater detail the interoperability results. These results, as reported, examine aspects of technology, unit level skills, operational planning and general readiness issues as determined by the demonstration. Copies of the subject reports may be obtained via the directorate of army doctrine.

CID BOREALIS 2002 was a major success. It was the first time that the ABCA armies actually conducted an interoperability demonstration to determine and validate degree of CIS interoperability. The results were conclusive. ABCA has major CIS interoperability issues that need to be addressed as individual national priorities and as a program, particularly as the ABCA standardization program remains committed to supporting the war fighter effectively, in future coalition operations. CID BOREALIS 2002 findings represent a treasure trove of information that will need to be carefully mined by each nation, many of the ABCA working groups, and other entities to ensure the best value is gained from this major interoperability exercise.

BOOK REVIEWS

GAS! GAS! GAS!

No Place to Run: The Canadian Corps and Gas Warfare in the First World War

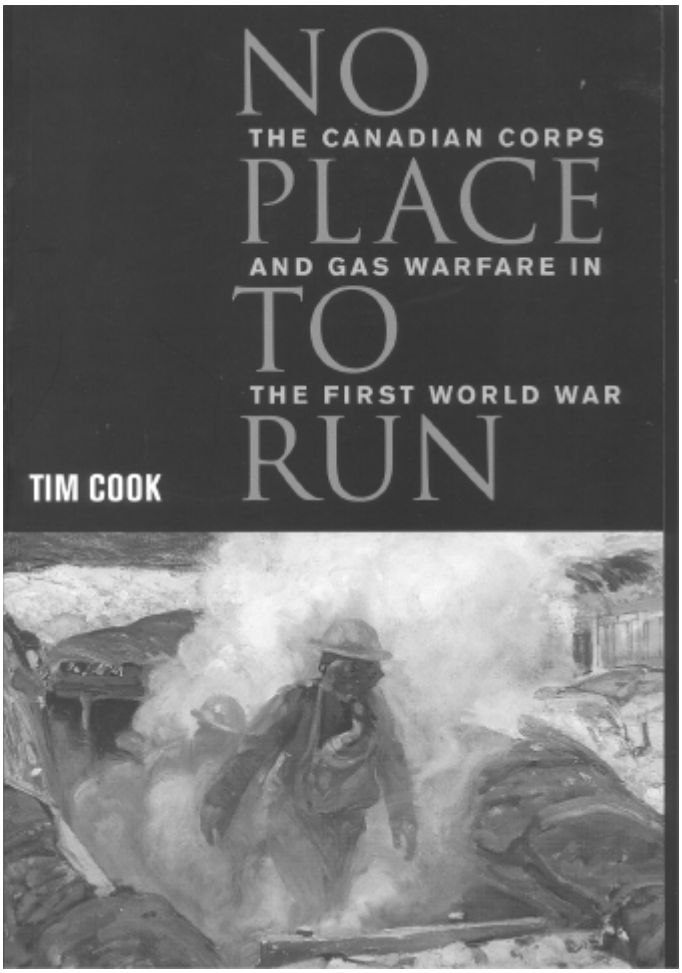
by Tim Cook, Vancouver: University of British Columbia Press, 1999, 296 pages.

Reviewed by Major A.B. Godefroy, MA

> *The body showed definite discolouration of the face and neck and hands. On opening the chest the two lungs bulged forwards. On removing the lungs there exuded a considerable amount of frothy light yellow fluid, evidently highly albuminous, as light beating was sufficient to solidify it like white of egg. The veins on the surface of the brain were found greatly congested, all the small vessels standing out prominently...*[1]

Commanders take note. With the possibility of a chemical war casting its ugly shadow in the direction of the Canadian Forces, there is a new imperative to understand the harsh realities of fighting in this unforgiving environment. While many have suggested that chemical battlefields show the new face of war, astute military readers know that Canada's Army has been there before. In the spring of 1915, the 1st Canadian Division, defending the Ypres Salient in Belgium, was attacked by elements of the German 26th Reserve Corps and 27th Reserve Corps employing chemical weapons. It was the first of three long years of warfare on the Western Front where gas and other chemical agents were regularly employed by both sides in support of conventional attacks. Tim Cook's No Place to Run: The Canadian Corps and Gas Warfare in the First World War presents a vividly descriptive and candid analysis of the Canadian Army's experiences with chemical warfare during the First World War.

Despite the fact that nearly a century has passed since the start of the bloodshed once termed as "the war to end all wars" relatively little has been written on Canada's experience in that conflict. After a flurry of first person accounts in the 1920s and 1930s, only one volume of Canadian official history appeared in 1933, followed by an apologetic all encompassing one volume official history by Colonel G.W.L. Nicholson of the Army Historical Section in 1962. Over the past four decades, however, aside from a half dozen or so original works by Canadian historian Desmond Morton, the field of study on the Canadian Expeditionary Force (CEF) remains sparse.



Tim Cook has aimed to change that. A graduate of the War Studies Programme at the Royal Military College of Canada, No Place to Run originated from his

master's thesis on the subject and reflects the influx of new research that is appearing on the CEF. Never before has a book been devoted to the subject of the CEF and gas warfare, and this book is revealing in that not only did Canadian soldiers suffer from gas, they actively employed it as well. A well-researched piece, the book was awarded the C.P. Stacey prize for best Canadian military history publication in 2000.

Arranged chronologically, No Place to Run takes the reader through the evolution of the CEF's experience with gas warfare on the Western Front. From the Second Battle of Ypres in April 1915 through to the last hundred days, each chapter examines the impact of new agents put into service by the German Army and the Canadian response to that threat. It also addresses the use of gas by the CEF, something that has received scant historical attention in the past.

The human element of gas warfare in the Canadian Corps is also well represented in this book, and the author spared no effort is ensuring as many personal anecdotes as possible were included giving the reader a very clear idea of both the physical and psychological impacts of gas warfare on the soldier. The quote at the beginning of this review is but one of many morbidly descriptive accounts of soldiers drowning in their own fluids, unable to breath or clear their lungs of the poisonous fumes that consumed them. Those who were lucky enough to survive may have questioned that luck when the gas left them blind, blistered, and permanently scarred. Worse, the doctors and nurses devoted to treating inflicted Canadian soldiers became casualties themselves after repeated exposure to gas-soaked uniforms. Gas was a terrible weapon. It left an unforgettable reminder of the incredible savagery that is total war.

The book breaks new ground in a relatively neglected area of research and is very readable considering that it is essentially a technical history of the subject of gas. Technical histories are challenging in their own right, and few Canadian military historians will tempt them, choosing instead to find comfort in operational or political military history. Tim Cook has taken up the challenge and, I would argue, succeeds in bringing this story out.

Yet No Place to Run is not without its faults. The author and publisher have assumed that the reader approaches the book with an advanced knowledge of the history of the Canadian Army on the Western Front. One might find it useful to have a copy of Nicholson's official history close at hand for reference. As well, though many places and battles are named, there are no maps provided, making it difficult for the unfamiliar reader to situate events and grasp the importance of what Cook is trying to present.

The subject may have benefited more from a thematic approach, rather than a chronological one, as the reader is often left wanting details related to the various aspects of chemical agents, how they were employed, and the means to counteract them. A good example of this is the book's treatment of the Canadian Corps Gas Services. While mentioned on several pages, the reader is offered only the most generic description and analysis of its organization, role, and activities. Given the nature of the book, one might have expected a whole chapter devoted to this organization.

Also, while there are photos throughout, they are the "usual suspects"–photos of gas-masked soldiers that have regularly appeared in other publications. This reviewer felt that an opportunity to present more original work was missed. Thousands of Canadian Great War photos remain buried in the National Archives of Canada with little hope of seeing the light of day unless an adventurous historian brings them to publication. Being a technical history of gas warfare, this reviewer was also surprised that the work did not contain a single technical drawing or diagram of chemical distribution or protection equipment.

Despite these issues, No Place to Run remains a groundbreaking piece of CEF history and hopefully has set a precedent for other books to follow.

Captain Godefroy is the commander of the Joint Space Support Team at the Canadian Forces Joint Headquarters in Kingston, Ontario.

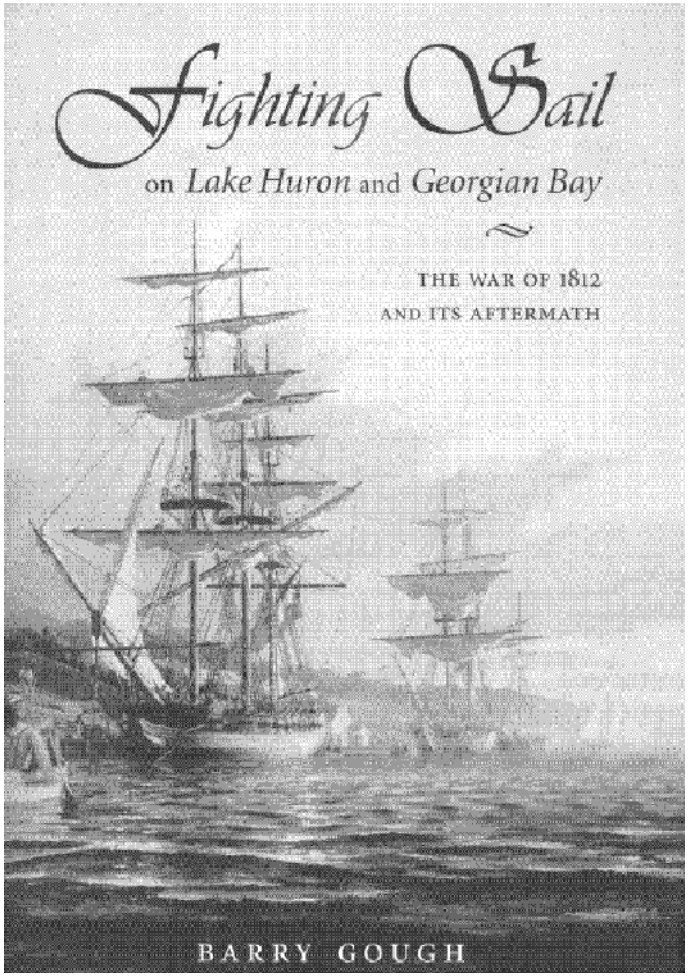
ENDNOTE

1. Tim Cook. *No Place to Run: The Canadian Corps and FAS Warfare in the First World War*. Vancouver: UBC, 1999, p. 29

The Great Lakes and Military Strategy

Barry Gough, *Fighting Sail on Lake Huron and Georgian Bay: The War of 1812 and Its Aftermath*, St. Catharines: Vanwell Publishing Ltd., 2002, 215 pages, with appendices, endnotes, bibliography, index, five maps and twenty-nine illustrations. CDN $39.95. Annapolis: Naval Institute Press, 2002, US $32.95.

Review by Robert Malcomson



During the War of 1812 military campaigns in the northern theatre prospered for one army or the other when its navy held dominion on the adjacent lake, so control of Lakes Ontario and Erie was a critical component of the strategies developed by Britain and the United States. On Lake Huron and Georgian Bay, the situation was different. Only small military detachments occupied the few outposts in this region, and gaining supremacy of the waters secured dominance in the fur trade, which brought with it alliances with the aboriginal nations, not to mention financial profit.

The British won command of these waters on17 July 1812, when they captured the American post on Mackinac Island. Captain Charles Roberts led a force of 50 regulars, 180 traders and 400 natives in canoes and batteaux from his post at St. Joseph Island (50 miles north of Mackinac) and invested the weakly manned American fort. Its commander, Lieutenant Porter Hanks, surrendered without a fight, handing Britain command of the trade route and galvanizing its bond with the natives. Britain did little to enhance its dominion in this region until late in 1814, when it began developing a naval station on the southern shore of Georgian Bay.

The capture of Mackinac further slewed the strategy of the United States, which was already misdirected. Instead of centring its military and naval thrusts on Lower Canada, President James Madison's government prosecuted campaigns across the Detroit and Niagara Rivers, as well as across the Upper St. Lawrence. This was done to protect the border states from British and native infiltrations and to avoid losing votes, but the strategy diffused the limited resources of the nation. Efforts to regain Mackinac drew even more resources away from the other campaigns in 1813 and 1814 and thereby further weakened the American war effort. The end goal of Oliver Hazard Perry's appointment on Lake Erie was to regain control of the upper waters, but he "gave up that ship" almost as soon he won the Battle of Put-in-Bay in September 1813. The next year the government sent Commodore Arthur Sinclair to Lake Huron when he should have been supporting Major General Jacob Brown on the Niagara Peninsula. Sinclair destroyed three small British vessels, lost two of his own to raids and failed to retake Mackinac. The war ended a few months later and, by the Treaty of Ghent, Mackinac was returned to the Americans.

Compared to the action that took place in the other centres of the northern theatre of the War of 1812, very little happened on Lake Huron and Georgian Bay which might explain why it has rarely, if ever, been the topic of book prior to the publication of *Fighting Sail*. The author is the widely published Canadian historian Barry Gough who, besides his M.A. and Ph.D., received a Doctorate of Letters (D.Litt.) for "distinguished contributions to imperial and Commonwealth history." He is a fellow of the Royal Historical Society and past president of both the North American Society for Oceanic History and the Canadian Nautical Research Society. He is Archives Fellow of Churchill College Cambridge and

the editor-in-chief of *The American Neptune: Maritime History and Art*.

Some readers will, no doubt, enjoy Gough's rendition of the handful of small actions that took place on these waters and the manner in which he gives most of the devoted individuals their due attention. Others may be put off, however, by his tendency to exaggerate. Captain Charles Roberts, for instance, was hardly a "military genius" (p. 25) who "deserves a place in the pantheon of military heroes"(p. 24). And it is quite a stretch to suggest that, during the late summer of 1814 when "the two armies [at Niagara] were locked in combat. . . . The only fulcrum of power was Michilimackinac, where the garrison was holed up awaiting supply and the course of events" (p. 108). Stringent editing would have refined the author's style and would have helped to straighten out the narrative, which flips back and forth in the chronology throughout the book, often without reference to date and context. As an example, consider the second chapter, which begins with June 1812, goes back to the previous January, leaps forward to the next winter, slips back to September 1812 and then proceeds to January 1813, all within three pages.

A knowledgeable editor's eye would have caught the too-frequent errors in fact and terminology too. Other sources have clearly shown that Lieutenant Miller Worsley, RN, arrived on the lakes in May, not July, 1813 (p. 104). The *Tecumseth* and *Newash* were built on the same design in 1815, not 1814 (pp. 147, 155). The *Nancy* could hardly have been taking on cargo for Sault Ste. Marie in the spring of 1790 (p. 59) if its owners did not order its construction until "late summer 1790" (p.58). An illustration in the Royal Ontario Museum collection of the British schooner *Sauk* was certainly not "the only record of a lakes schooner constructed in pioneering days" (p. 156) prior to the discovery of the *Hamilton* and *Scourge* in 1975. If this last egregious error does not cause students of the War of 1812 to put this book down, then Gough's persistence in using HMS (His Majesty's Ship) to refer to schooners, brigs and sloop-rigged vessels certainly should.

The problems with *Fighting Sail* extend beyond matters of fact and style. The work does not rest upon a foundation of thorough research. Gough depends heavily upon secondary sources, frequently lifting quotes from such texts rather than searching out their original sources.[1] Vast collections of primary documents are available in many prominent institutions, but the author makes scant use of them. So it is no wonder that we see such a blatant misrepresentation of circumstances in the introductory chapter, when the author claims that the British assumed an offensive strategy at the beginning of the war and that the "mastermind of its new imperial quest" (p. 3) was John Graves Simcoe, Upper Canada's first lieutenant governor. Gough bases his view upon Simcoe's plans in the 1790s, few of which came to fruition, and backs it up with reference to a single pre-war report written by the military secretary of Sir George Prevost, Commander-in-Chief of the forces in British North America. He alludes to his thesis throughout the book, often as an aside; in a late chapter, for example, Gough refers to the "man-of-war HMS *Sauk*" as "a workhorse of empire on the upper Great Lakes" (p. 156).

There is nothing wrong with offering a revised view of events and their causes, but the evidence that Gough provides for his thesis is inadequate. Documents concerning the formation of British strategy abound with the extensive correspondence that passed between Prevost and Major General Isaac Brock being but one source of information. Had the author made a complete examination of this material, he would have realized that the British assumed a defensive strategy before the war for a number of reasons and did not lift it until mid-1814. He would have also learned the part played by the British home government in forming this strategy and approving the steps Prevost took to hold the line in Canada. Curiously, Gough states in the second chapter that Prevost "masterminded defense strategy and, out of necessity, ordered prudent measures for Canada's protection"(p. 24), but this is in direct contradiction to what Gough says elsewhere and is a rare representation of the clearly established facts.

Naval events on the upper lakes like those on Erie, Ontario and Champlain did not occur in isolation. They were all part of a larger context, the "big picture," that government officials and the military and naval commanders conceived and implemented. Prevost, Commodores Sir James Yeo, RN, Isaac Chauncey, USN, and Arthur Sinclair, USN, and the secretaries of the American navy and war departments were the men who directed affairs in the northern war of which the upper lakes was one branch. A full understanding of events on the upper lakes requires an explanation of the circumstance under which these principal leaders operated and their subsequent decisions, but such is

not to be found in *Fighting Sail*. Again, a look at the research done reveals its failing: among the 320 endnotes there are attributions to fewer than two dozen letters written by the men noted above.

A glaring example of how the lack of background limits the value of this book is seen in the chapter about the battle of Put-in-Bay. There is but a thin discussion of the reasons behind the Lake Erie campaign or its end goal. We do not read of Washington's preoccupation with regaining the Detroit frontier and the upper lakes and how it was one of Commodore Chauncey's objectives to achieve this. There is only a superficial description of the army under William Henry Harrison and very little about how he and Perry coordinated their efforts to invade southwestern Upper Canada. We have a rambling description of the lead up to the battle at Put-in-Bay and the fighting itself, which is marred by errors and omissions, most notably a comprehensive examination of the opposing squadrons. In the follow up to the battle, Gough avoids the Perry/Elliott controversy (due to lack of relevance, he says) but devotes four pages to a treatment of Commander Robert Barclay's court martial. Missing, however, is that fact that long before Barclay's court martial, the loss of the Lake Erie squadron excited so much concern in England that a large reinforcement of men and pre-fabricated ships was ordered to Canada in January 1814. Part of the intended use of this force was the creation of a new naval base on the upper lakes which resulted in the first development of British naval and military posts on Georgian Bay. This repercussion to events at Put-in-Bay is perfectly relevant to the topic of this book but is not mentioned.

The title, *Fighting Sail on Lake Huron and Georgian Bay: The War of 1812 and its Aftermath*, is misleading. As just mentioned, Gough devotes a chapter to Perry's campaign, and the book jacket features a painting by Canadian artist Peter Rindlisbacher of ships in the British Lake Erie squadron, which never sailed above Lake Erie. While one of Rindlisbacher's Georgian Bay scenes would have been a better selection, the topic of this book is inextricably linked to events on Lake Erie, and a more appropriate title would have been *Fighting Sail on the Upper Lakes*. This would have made it easier for the author to explain how the naval base at Amherstburg was transferred to the mouth of the Grand River following the war. This station had an importance equal to that of Penetanguishene and deserved a more thorough description here. But, again, the lack of thorough research prevent this. The exquisitely detailed memoir of Lieutenant David Wingfield (who served on the lakes until 1817), which is held by the National Archives in Ottawa, might have been utilized to fill out the details of post-war developments.

Worth noting are the excellent maps prepared by Christopher Johnson, who is quickly becoming recognized as the go-to man for graphic work concerning military and naval affairs of the period. As a whole, however, I cannot recommend this book to anyone who is interested in more that a partial coverage of the age of fighting sail on the upper lakes.

Robert Malcomson is the author of Lords of the Lake: The Naval War on Lake Ontario, 1812-1814 (Toronto: Robin Brass Studio, 1998), Warships of the Great Lakes: 1754-1834 (Rochester, UK: Chatham Publishing, 2001) and numerous articles about the age of fighting sail on the Great Lakes. His latest book, A Very Brilliant Affair: The Battle of Queenston Heights, 1812, will be published by Robin Brass Studio in the spring of 2003.

ENDNOTE

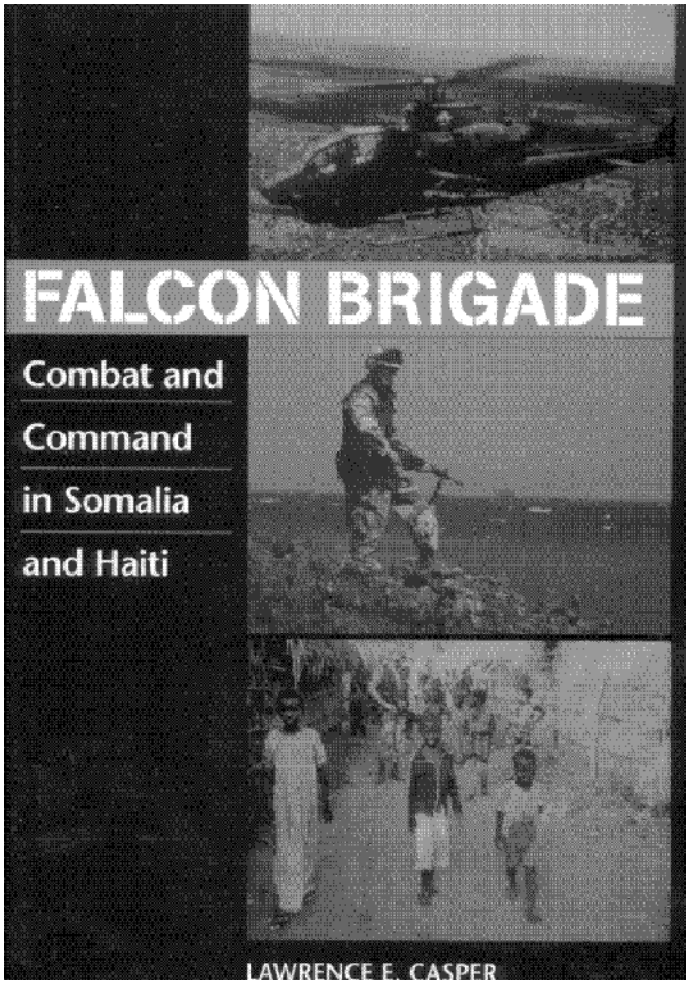
1. In the bibliography "assorted C series documents of the army on the defense of Upper Canada" are inaccurately included in the reference to the Colonial Office (CO 42), which form Manuscript Group 11 in the National Archives of Canada. The "C series" is an outdated term for the British Military and Naval Records, Record Group 8, I. There appear to be only three references to material from RG 8, I, in the endnotes.

Lessons Learned from Modern Conflict…

Falcon Brigade—Combat and Command in Somalia and Haiti

by Colonel (Retd) Lawrence Casper, Boulder, Co: Lynne Rienner, 2001, 257 pages.

Reviewed by Major Raymond Farrell, CD



Falcon Brigade is the nickname of the 10th Aviation Brigade of the American 10 Mountain Division. The author, Colonel (retd) Casper, was its commander over a two-year period spanning expeditionary deployments to Somalia and Haiti. He has a tale to tell.

Colonel Casper assumed command of the Falcon Brigade in Somalia three days before the events of October 1993, famously described in the book *Blackhawk Down* and the film of the same title. While *Blackhawk Down* tells the story from the point of view of the special operations troops of Task Force Ranger, Casper tells the other side of the American story. At the time of the 3 October battle, 10 Aviation Brigade was the largest US combat force in Somalia. Based in Mogadishu, and consisting of a battalion of light infantry and a mixed aviation battalion, it was the reserve for both UN and US forces in Somalia. The substantial force the United States had provided to the Unified Task Force (UNITAF) in the first months of 1993 had gone home when UNITAF was replaced by United Nations Operation in Somalia II (UNISOM II) in May. Following the debacle of 3 October, considerable US forces would return to Somalia, but at the time of the battle, US Forces Somalia consisted largely of support troops, special forces and Falcon Brigade.

Colonel Casper provides a useful but brief introduction to the situation in Somalia before plunging right into the fight of 3 and 4 October. Of course, this is how it must have seemed to the author at the time, finding himself in the midst of an unforeseen raging battle on the third day of his command. Casper's troops formed the bulk of the ground extraction force for the trapped special forces, provided aviation support with gunships and conducted surveillance. He tells their story with obvious pride but, by necessity, distance. On the other hand, his perspective on the various US commanders and their reactions to the unfolding disaster are personal and immediate. Casper observed or participated in every decision taken after Task Force Ranger's mission began to go awry, and he knew many of the personalities involved. That he was not involved in or even aware of the planning of Task Force Ranger's mission until it was launched is clearly a source of some bitterness for him. Although he takes a professional view of the need for operational security, he clearly feels that over compartmentalization was a weakness in US planning in Somalia. Interestingly, he makes the same observation again when describing the successful operation in Haiti.

Falcon Brigade describes the action of 3 October at length but also describes subsequent operations in Somalia as well. Colonel Casper describes first-hand how the US political and military situation changed in reaction to that battle and, in particular, to the unexpectedly heavy casualties. His comments on risk-aversion, force posture, unity of command and humanitarian operations in general are fascinating, especially to a non-American reader. Like most soldiers, Casper is intensely proud of his own army, but he is quite capable of self-criticism. Just as

interesting, however, is the picture he builds up, unintentionally, of the US approach to operations other than war. Throughout the book, whether praising or critiquing, the author's comments reveal a uniquely American view of peace support operations, which will be of interest to anyone who has or might serve in a US-led force on such a mission.

The second part of the book deals with the American invasion of Haiti on 19 September 1994. In response to spiraling chaos in that country, the United States forcibly re-instated former president Jean-Bertrand Aristide, who had been democratically elected in 1990 and then overthrown seven months later. Even as US forces were completing their withdrawal from Somalia, the crisis in Haiti was building so that planning for an invasion began within three months of Falcon Brigade's return from Africa. From Colonel Casper's point of view, planning was very fast considering the complexity of the operation. The brigade commanders of 10 Mountain Division received their first warning a mere six weeks before the operation was launched. Across the division, preparations were complicated by the necessity for security and the generally vague nature of the plan. In 10 Aviation Brigade, there were additional complications stemming from the poor conditions of the brigade's airframes after operations in Somalia and the requirement to train and qualify pilots in carrier operations. To top it off, the brigade was in the middle of re-equipping from AH-1 Cobras to AH-54D Kiowa Warriors. Casper's account of the planning and mounting of this operation will elicit smiles from anyone who has ever been involved in "hot planning." While the invasion itself turned out to be less dramatic than events in Somalia, the operation was in many ways every bit as challenging. Colonel Casper's observations on working with the navy are very practical and would be invaluable to anyone in a similar situation. Indeed, the book is worth its price for the chapter on carrier operations alone.

The book concludes with a discussion of lessons learned from both missions. Most of these are uncontentious, as he admits, restatements of well-worn military truths.

This is a good book. Colonel Casper writes well and tells his story in a readable but direct way. It is a personal account, but it is not a memoir. Rather, the author is a soldier interested in sharing his (considerable) experience. For example, there are almost no details of Colonel Casper's personal life or opinions. As well, the book is almost totally devoid of humour. His relations with other officers and men are typically sketched in one or two lines rather than treated as subjects in their own right. In fact, one of the few criticisms I have with Colonel Casper's style is his inability to describe real personalities. Almost without exception, every soldier he describes comes off as a good guy with one defining trait (tall, fit, aggressive, etc.). Even Casper's direct supervisors warrant only a few words, although their personalities would presumably have had a big effect on Casper's command relationship. Nevertheless, this is not a serious weakness because *Falcon Brigade* concentrates almost exclusively on what happened and why. To be sure, there are anecdotes that digress from the main narrative and longer passages in which the author expresses opinions, but these tend to illustrate or set the scene for lessons learned. Very little is irrelevant.

Apart from a few editing mistakes (affect vs effect, etc.), the production quality of this book is excellent. It is illustrated with a number of black and white photos of mixed quality but benefits enormously from some excellent maps, air photos and diagrams. There is a passable index and, as befits any book written by a soldier for soldiers, there are even a couple of organization charts.

Colonel Casper has written a "lessons learned" account of his brigade's operations in Somalia and Haiti. From that point of view, it is an excellent book. The author has useful observations on aviation, joint operations, planning, training and leadership. Nevertheless, *Falcon Brigade* is not for everyone. Readers looking for an exciting account of combat may be somewhat disappointed, but the serious student of military art will refer back to this book more than once.

Major Raymond Farrell is a battery commander with the Second Regiment, Royal Canadian Horse Artillery(RCHA) in Petawawa.

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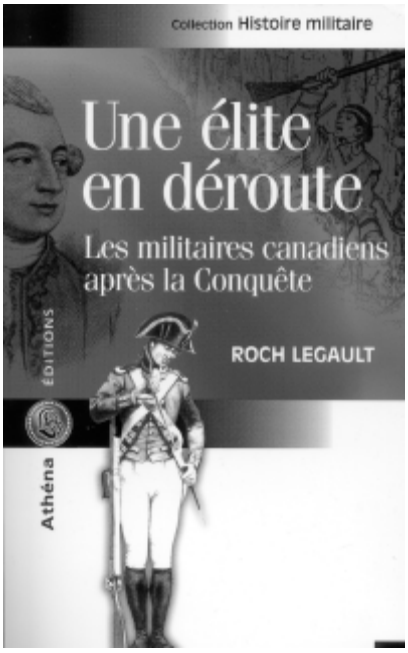
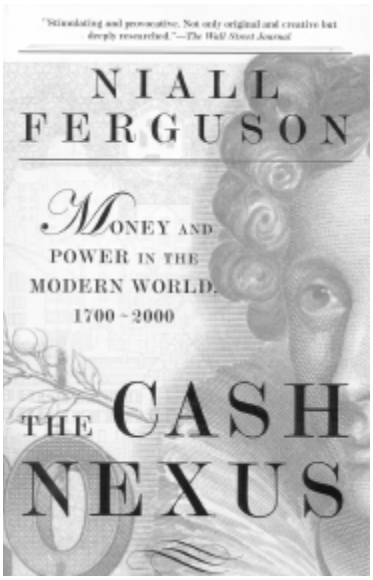
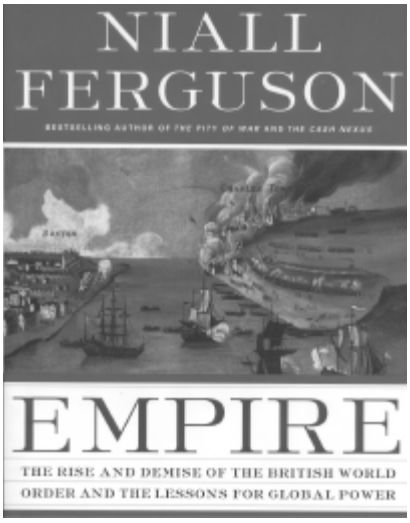


Roch Legault. *Une elite en deroute. Les militaries canadiens apre la Conquete*. Outremoent: Athena Editions, 2002. ISBN 2-922865-10-X. This book is the first study of French-Canadian officers who remained in the army following the fall of New France to 1815.

Charles Whiting. *Monty's Greatest Victory: The Drive to the Baltic, April—May 1945*. Leo Cooper, 2002. ISBN 0-85052-909-3. An examination of Monty's successful bid to turn his "flanking" role into a strategic race against the Soviets for the control of Baltic ports and the implications that had on post-war Europe.



Niall Ferguson The Cash Nexus: Money and Power in the Modern Worlds, 1700-2000. New York: Basic Books, 2001. ISBN 0-465-02325-8. This study challenges the prevailing wisdom regarding the relationship between economics and politics arguing that political violence and war have driven financial innovation and change.



Niall Ferguson. Empire: The Rise and Demise of the British World Order and the Lessons for Global Power. New York: Basic Books, 2002. ISBN 0-465-02328-0 (US) or 0-713-99615-3 (Britain). An original reappraisal of the British Empire by the enfant terrible of the Oxford history establishment, and how it gave rise to modernity, through a formidable array of pirates and pioneers, missionaries and mandarins, bankers and robber barons and what that means for today's global power.

The Stand-up Table

Commentary, Opinion and Rebuttal

Commentary on "The Corporals' Report" by Corporal W.C. Gomm and Corporal R.K. Moran, *The Army Doctrine and Training Bulletin*, Vol. 5, No. 3.

Sergeant D.K. Loader of 3 Area Support Group, Gagetown writes...

It was with great enthusiasm that I read "The Corporals' Report" and I found many interesting and innovative ideas within it. However, I found quite a few points where more diligent research would have stood Corporal Gomm and Corporal Moran in good stead. Most of these points involve either the technical or the logistical feasibility of the proposed changes, while others deal with the practical application of the changes.

The statement that wire-guided missiles are outdated is false. Wire-guided missiles have several advantages over fire-and-forget missiles at longer ranges. They are more resistant to countermeasures than a fire-and-forget missile. In order to jam a linked missile, the launcher must be defeated. As the launcher is further away than the fast approaching missile, this is harder than defeating the missile. The Spike/Gill, a very modern anti-tank missile with a 4000 m range, requires fibre optic guidance beyond a certain distance to ensure a hit. At short ranges, it can be fire and forget, but then one of its main advantages—the ability to change targets if the first one is destroyed or obscured—is lost. In the case of the Spike/Gill, having the missile linked to the firing post provides the section commander with a disposable, short-range unmanned aerial vehicle that he can use to see over hills or trees. While wire itself may be replaced by fibre optic cable, a link between the firer and the missile should not be thought of as outdated.

All this said, I do believe that the Eryx system should be scrapped as soon a possible and replaced with Javelin for use at the section level. Higher-level anti-armour assets should include a missile like the Dandy member of the Gill/Spike family. This missile has an 8-10 km range. It would be vehicle or helicopter mounted and have a secondary use as a one-shot unmanned aerial vehicle.

Carrying on with anti-armour changes, I have a technical problem with proposing an armour-piercing, fin-stabilized, discarding sabot-tracer (APFSDS-T) round for the Carl Gustav. Currently there are programmes looking at shoulder-launched kinetic kill mechanisms, but the ranges are very short and the timelines for introduction long. The engineering hurdles in producing a portable, shoulder-fired munition that kills by kinetic energy are immense. There is a round available for the Carl Gustav—the FFV751, a tandem warhead high explosive anti-tank (HEAT) round-that would meet the requirements outlined in "The Corporals' Report," except for the 1000 m range.

I believe the changes proposed to the armoured battalion would quickly leave the infantry with no large direct fire support weapons when operating in complex terrain. Both the Russians and the Israelis have discovered that armour protects better than speed especially in urban terrain. This has lead to the introduction of such armoured personnel carriers as the Achzarit and BTR-T to work alongside heavy armour in city fighting. Furthermore, the 2nd Battalion, The Royal Canadian Regiment (2 RCR) discovered that the LAV III cannot move and maintain an accurate sight picture at speeds higher than 15 km/h.[1] Unless the 105 mm version has enormous technical advances in stabilization, the high-speed mobility of the LAV III will be eliminated if there is a requirement to fire. By moving to a light armoured vehicle (LAV) family of vehicles, Canada is restricting itself to conducting operations in open, smooth terrain if it wants to have a chance of surviving.

With regard to the restructuring of the infantry battalion recce platoon, I have to question the wisdom of replacing the Coyote with the Grizzly. Why would one move backwards in terms of protection and mobility? The Grizzly does not have the low profile or full-speed reverse available on any of the other, older recce vehicles such as the Lynx or Dingo. The proposed turret is fine for close defence against infantry and soft-skin vehicles but completely inadequate against any vehicle with a decent amount of armour. While one might argue against giving a recce vehicle a weapon such as the Bushmaster, it should be thought of as contingency planning for the worst-case scenario. Given the speed of the modern battlefield, perhaps recce elements should carry heavy weapons to allow them to fight their way out when speed is not enough.

The proposal for the new air defence (AD) squadron simply does not make any sense to me. We would be replacing a highly effective (if temperamental), jam resistant, multi-function system with a short range, easily decoyed, clear weather only system. The Army would be loosing any semblance of a mobile air defence radar system except Skyguard, which is a relatively static system. The LAV-AD variant would be able to

keep up on the road but must be stationary to fire, thereby loosing its mobility advantage over the air defence anti-tank system (ADATS). LAV-AD also has no early warning system other than its own FLIR and 60% of the range of ADATS.

The concept of replacing tube artillery with rocket artillery should be modified to have tube artillery supplemented by rocket artillery. As it stands now, the Army does not have enough lift to sustain its brigades in combat. Tube artillery is much more efficient than rocket in lift capability. A single heavy logistic vehicle wheeled (HLVW) can carry approximately 100 projectiles, charge bags and fuzes. Going to a modular propellant system and a palletized unit load system could further optimize this. Currently our 105 mm C2 and LG1 howitzers can outrange our 155 mm M109s. This discrepancy can be corrected by moving to a longer barrel and base bleed projectiles, thus providing a 39 km+ range. Rocket artillery has a definite use in delivering shock and awe on the enemy, but it is not suited for sustained fire. Tube and rocket artillery are two systems that each do specific tasks extremely well but cannot do everything. If we were to remove one system, we would be cutting a hole in our capability to patch another one.

There is one final point that I believe "The Corporals' Report" has failed to address—logistics. I do not believe the Army has the capability to lift sufficient ammunition over land to make sustaining a battle group, let alone a brigade, in combat an option. Each rifle company needs one HLVW to carry an additional load of 25 mm ammunition for each LAV III.[2] This does not include any other calibre or nature of ammunition. Currently 2 RCR has one HLVW dedicated to ammunition. When H Coy of 2 RCR deployed on Op ECLIPSE there were no dedicated ammunition vehicles. Lift space for resupply of ammunition had to compete with water, rations and general stores to be moved from the log base to the company. The lift capability may be present within the Army, but it is scattered, and gathering it together would strip units.

As I stated at the start of this letter, I mainly have problems with the technical aspects of "The Corporals' Report." I agree with and applaud the remainder of the report that deals with the structure of the forces and training. I wish the best to the two members who wrote it and hope someday to see some of their ideas in action. I congratulate The Army Doctrine And Training Bulletin for having the courage to print an article by two corporals. I believe that ten years ago such an article would have been dismissed by the editors, regardless of the experience and knowledge of the authors, simply because of their rank.

ENDNOTES

1. Maj William G. Cummings, *Night Fighting Doctrine and TTP for the LAV III—A Reality?*, http://armyonline.army.mil.ca/LFAA/D43351.asp, p. 6

2. Each LAV III carries 420 rounds. Each pallet holds 1260 rounds or enough for three LAV IIIs. At 15 LAV IIIs/platoon, five pallets are required. Each HLVW can carry eight pallets. Currently each pallet only holds one nature of ammo, so if a mixture (AP/FA/HEI) is desired, the pallets must either be broken down in the rear or extra pallets of different natures must be carried.

"On the Importance of Doctrine..." *The Army Doctrine and Training Bulletin*, Vol. 5, No. 3, (Fall 2002).

Colonel Mike Cessford, of the Directorate of Defence Analysis writes...

My friend Chuck Oliviero is nothing if not dependable. His review of Robert Citino's *Quest for Decisive Victory: From Stalemate to Blitzkrieg in Europe, 1899-1940* is concise, illuminating and provides a helpful and professional assessment of the merits of the book. I look forward to reading Citano's latest offering and suspect it will provide a useful companion to Robert Doughty's *The Seeds of Disaster: French Army Doctrine, 1919-1939*. However, again inevitably, Mr Oliviero cannot forgo the opportunity to disparage Canadian tactical doctrine in combat in Europe in the years 1944-1945. His final paragraph, misplaced and disconnected as it was, was simply so bad that even someone as kind, mild and forgiving as I cannot pass it by in silence.

The tone is set as we learn that the Canadian Army of the Second World War stands condemned by every Staff College student who has graced the halls of Fort Frontenac—this for its apparently congenital inability to do more than win the first round of the tactical fight. Unspoken, but nonetheless evident, is the suggestion that even these imperfect successes were clearly the result of ponderous preparation and overwhelming material support. However, once the Canadians reached the green fields beyond, they were

clearly no match for the unfailingly professional and ever victorious German forces.

It is, however, with some relief that we learn that our army's enemies are far more generous than its Staff College progeny. The valiant *Oberleutnant* (his *Wehrmacht* rank as opposed to his *Bundeswehr* rank) Gerhard Mumm, 29th *Panzer-Grenadier Division*, is gracious in his praise of the Canadian Army in the initial attack and tactfully silent in his assessment of their subsequent failings. Indeed, we learn that he had earned the Iron Cross First Class for his actions at San Fortunato ridge, successfully delaying a Canadian battalion that, one assumes, should have long before been in Venice. The irony is delicious.

It is also a gross misrepresentation of the facts—a point evident in even a cursory analysis of Canadian tactical operations in the Second World War. Since it has been raised, why not take the opportunity to examine to see what actually happened at San Fortunato ridge?

The Canadians were fighting the Germans at San Fortunato ridge as a consequence of their brilliant assault on the Gothic Line and their subsequent exploitation deep into the enemy rear. How can this be? The Canadians "never" exploit their successes—and yet, in an attack off the line of march on 30 August 1944, the 1st Canadian Corps broke the Gothic Line, turning (among others) the veteran 26th *Panzer* and 1st *Fallschirmjaeger Divisions* out of their positions and upsetting the entire German defensive concept of operations for northern Italy. Initial tactical success was transformed into an operational victory as, within the space of three days, the Canadians achieved a penetration of over 10 km into the German defences. It is true, the Canadians were denied the full fruits of their victory as a consequence of the misemployment of the British 8th Army's reserves—but no blame, in any assessment, accrues to the Canadian Corps. The 8th Army had weighted its forces too far west, and a delay in moving the British 1st Armoured Division from Army reserve allowed the front to harden as the stunned Germans poured reserves into the battle area. The Canadians, brought back into the fight on 13 September, knocked the Germans off Coriano Ridge and then began the process of pushing north to the town of Rimini.

This brings us to the celebrated fight for San Fortunato ridge. On the night of 19/20 September, the 1st Canadian Infantry Division assaulted the ridge in a well-planned, two-brigade attack. The initial assault was made by the Royal 22e Regiment with the task of securing positions on the western edge of the ridge. Space does not permit, but suffice to say that the attack was a resounding success: one company alone took over 65 prisoners, as well as inflicting a significant number of wounded and dead on the German defenders—this at a cost of very few Canadians wounded or killed. The battalion commander, Lieutenant-Colonel Jean Victor Allard, received a well deserved bar to his Distinguished Service Order for this action.

With the R22eR firm on its objectives, The West Nova Scotia Regiment and Seaforth Highlanders exploited (damn–there's that word again) this success to clear the remainder of San Fortunato ridge. These two units reported 326 prisoners taken as they cleared the eastern edge of the ridge. However, of even more interest was the execution of a night battalion infiltration by The Loyal Edmonton Regiment to take the village of San Lorenzo in Monte—a potential strongpoint located some 1500 metres beyond the ridge. The lead Edmonton company destroyed a Tiger (and supporting infantry) in close combat en route and then captured the village just before the arrival of the German unit detailed to occupy it. Large numbers of the surprised Germans were killed or wounded while another 50 prisoners were taken. Subsequent counter-attacks were broken up without shaking the Canadian grip on the town.

The Germans saw this defeat for what it was, and that same day the 76th *Panzer Corps* requested permission to withdraw its forces north of the Marecchia River, in effect surrendering the town of Rimini to Allied forces. Kesselring immediately approved the request, and the remnants of the battered German forces pulled behind the river. Rimini fell to the Greek Brigade (then attached to the 1st Canadian Corps) the next day, and, on 22 September the Canadians were withdrawn into 8th Army reserve.

It is perhaps most useful to allow final comment on the fight for San Fortunato ridge to come from the Germans. The German 10th Army's War Diary for 20 September reports:

> *29 Pz Gren Div: Beginning with the noon hours, the Division carried out a fighting withdrawal while warding off enemy attacks. Sometimes under particularly difficult conditions and in the face of sharp enemy pressure, the individual battle groups, in some cases led by non-commissioned officers, fought their way back. Time and time again they had to fight off attacks by the pursuing enemy; then fall back another few hundred yards. [Translation.]*

Hmmm...seems hardly the style of those somnolent Canadians.

Other examples abound—from Sicily to the Valli di Commachio. The 5th Canadian Armoured Division, the second division in the 1st Canadian Corps, certainly does not suffer from close examination of its operations. Leaving aside its superb performance at the Gothic Line, one need only look at Operation SYRIA (the clearing of the south shores of the Valli di Commachio) for a neat and textbook example of break-in and exploitation by armour and infantry. Over five days during the first week of January 1945, the 5th Division attacked and defeated elements from four German divisions, inflicting casualties at a rate of 5 to 1 on an enemy emplaced in terrain ideal for defence. The Germans were given no rest as the Canadians drove them back 20 km, completely clearing the south shore of the Valli di Commachio. A four-battalion counterattack by the 16th SS *Panzer-Grenadier Division "Reichsfuhrer-SS,"* was shattered at a cost to the Germans of hundreds of personnel killed, wounded and taken prisoner. The Canadian battalion that bore the brunt of the attack reported total casualties of seven men wounded.

Other examples abound but the point is clear. It is a dangerous practice to make broad and sweeping generalizations about such a difficult and complex a human activity as tactical combat—especially when even a passing review of the evidence would argue for caution. It is simply staggering to imagine that any army engaged in protracted tactical combat would cling desperately to moribund tactical doctrine, senseless to any suggestion that might spare them blood while inflicting greater loss on the enemy.

The truism is that no doctrine survives first contact with the enemy. Take it for a fact—experienced troops do not intentionally repeat the mistakes of their first engagements. They learn and adapt in ways that will maximize their chances for tactical success and personal survival. As a battalion and brigade commander in the 1st Canadian Infantry Division wrote,: "...the battlefield is the best training ground for war..., and that a commander who makes a mistake is unlikely to make the same mistake again."[1] To repeat, by September 1944, with many months of fighting behind them, the men of the divisions of the 1st Canadian Corps were as seasoned and capable as any in the Allied armies. To suggest that these troops would have ignored obvious opportunities for exploitation is supported neither by the evidence nor simple logic.

I would suggest that Lieutenant-Colonel (Retd) Oliviero talk to more Canadian veterans. I too remember *Oberleutnant* Mumm's insightful and useful presentation on his tactical experiences in the Gothic Line battles. However, I also remember the presence in that same audience of, among others, Captain John Dougan, MC and Bar, of the Loyal Edmonton Regiment. Captain Dougan was the company commander whose sub-unit took and held San Lorenzo in Monte. His accounts, and those of the other veterans, offer a useful corrective to those who, without apparent analysis, casually denigrate the tactical successes of Canada's wartime forces. I have talked to dozens of Canadian veterans, from private soldiers to generals, from riflemen to divisional commanders, and I have yet to meet one who considered himself less capable than his adversary. And why would they? Volunteers almost to a man, comparatively well equipped and lavishly supported, and with (by the summer of 1944) a cadre of experienced and capable tactical leaders, the Canadian Army gained an impressive record of battlefield success, in difficult operational environments, against the cream of the *Wehrmacht*. Of course, there were tactical defeats and setbacks. But, in general terms and by any set of objective measurements, the record of the Canadian Army in combat during the period 1944-1945, in Italy and Northwest Europe, is one of consistent tactical success.

ENDNOTE

1. Major-General (retired) M.P. Bogert, letter to the author, 13 September 1993.